DOCUMENT RESUME

ED 159 953 HE 010 365

AUTHOR Kistiakowsky, Vera
TITLE Women Doctoral Scientists in the United States (1973).
PUB DATE Jan 76
NOTE 113p.

EDRS PRICE MF-$0.83 HC-$6.01 Plus Postage.
DESCRIPTORS Demography; *Doctoral Degrees; *Employment Patterns; Employment Trends; *Females; Higher Education; Historical Reviews; National Surveys; Professional Recognition; Salary Differentials; *Science Careers; *Scientists; *Sex Differences; Sex Discrimination; Statistical Data; Womens Education

ABSTRACT

A demographic profile of women doctoral scientists in the United States is presented, based on the survey of doctoral scientists carried out by the National Academy of Sciences--National Research Council (NAS-NRC). In addition to an overview of the NAS-NRC survey, the presentation compares the demographic profile of women with that of men and highlights some important areas such as employment status, employer and primary work activity, employment at four-year colleges and universities, and salary. Because differences between career patterns of women and men scientists can seldom be explained with demographic data, the survey report is preceded by a capsule history of women scientists in the United States and is followed with a discussion of sex differences in scientific aptitude, cultural barriers, discrimination, dual career problems, and recent trends. The profile for women indicates a different distribution among fields than that for men, with percentages increasing from engineering to physical sciences, to life sciences, to their largest value in the social sciences. Larger percentages of women were unemployed, working part time by choice or full time in non-science jobs, and larger percentages of full time employed women than men gave teaching as their primary activity. Figures and tables with statistics are included with the text. (JMD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

Unpublished

ED159953

WOMEN DOCTORAL SCIENTISTS IN THE UNITED STATES (1973)

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Vera Kistiakowsky

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

Vera Kistiakowsky
Massachusetts Institute of Technology

January, 1976

HE 010 365

CU00017

TABLE OF CONTENTS

	Page
INTRODUCTION	2
HISTORICAL BACKGROUND	3
1973 PROFILE OF DOCTORAL WOMEN SCIENTISTS	8
NAS-NRC 1973 Survey of Doctoral Scientists	8
Distribution by Field and Other Characteristics	11
Employment Status	14
Employer and Primary Work Activity	18
Four Year Colleges and Universities	22
Salary	24
DISCUSSION	25
Sex Differences in Scientific Aptitude	26
Cultural Barriers	29
Discrimination	33
Dual Career Problems	36
Recent Trends	38
SUMMARY	42
ACKNOWLEDGEMENTS	45
REFERENCES	46
FIGURES 1-11	50
TABLES I-XXVII	

Introduction

This paper presents a demographic profile of women doctoral scientists in the United States based on the survey of doctoral scientists carried out by the National Academy of Sciences--National Research Council (NAS-NRC) in 1973. There have been several of previous studies of women scientists, and a number of these have been carried out for particular fields by committees of the relevant professional societies. Vetter and Babco [1] summarize many of these results and give a very complete bibliography of disciplinary and other studies. The data which are discussed in this paper are not as detailed with respect to the particular fields, but they present the advantage for interdisciplinary comparison of a single sampling technique for all fields and one which is well understood. There have also been several interdisciplinary studies which have examined the situation of women doctorates or academic women and discussed the apparent causes [1-10]. For example, the Centra study [9] examines a group of women doctoral recipients from three time periods and compares them with a matched sample of men doctorates. The analysis of these dates permit elucidation of a number of interesting questions, but this is not done separately for the scientists in the sample. None of the previous work contains a demographic profile of women doctorates in all the sciences based on an all-inclusive survey and therefore this study was undertaken.

The previous studies have pointed out differences between the career patterns of women and men scientists and thus it is not unexpected that this profile for women doctorates has been found to differ from that for men. The cause of the differences can seldom be found in the demographic data and it is necessary to turn to other sources for possible explanations. One approach to such an understanding is an examination of the historical background to the current situation. Therefore, the second section of this paper gives a capsule history of women scientists in the United States. The third presents the demographic profile of women doctorates in 1973 and compares it with that of men, and the fourth discusses possible causes of the differences and suggests some implications for the future.

Historical Background

The first woman scientist in the United States of whom there is a record was the eighteenth century botanist, Jane Colden (1724-1766) [11]. She was educated by her father, who had serious interests in botany and the physical sciences, and by 1757 she had written detailed botanical descriptions of more than 300 local plants and established an international reputation [12]. In the next one hundred years there were few other women scientists and they were also largely self-educated or educated by someone in the family circle or a family friend. In this period the American colleges offered mainly a classical undergraduate curriculum and scientific

education in general was not collegiate. However, even the secondary education necessary as a foundation to scientific studies was much more difficult for women to obtain and tertiary education was not available to women until 1837 when Oberlin College admitted its first female freshmen [13]. The first separate college for women, Georgia Female College at Macon, was chartered in 1836, but actually opened only in 1839 [13]. Subsequently, a few other male institutions became coeducational and a few more women's collegiate institutions opened. However, until after the Civil War, the number of these remained small and many were of inferior quality. There was considerable pressure during this period to make higher education available to women, and the failure to achieve success was part of a general pattern in which educational reforms remained blocked until after 1865, reforms including curricula with the possiblility of elective courses, scientific and technological education and graduate education [13]. However, the advocates of higher education for women were faced by special problems, including critics who felt that higher education would either physically debilitate the weaker sex or unsuit them for motherhood. It was not until it was demonstrated that collegiate education did not have adverse effects on women that such opposition was stilled. Two institutions which played important roles in effecting this change were Vassar College, founded in 1865, and Cornell University, which opened its doors to women in 1872 [13]. The success of the education of women at these institutions and the absence of deleterious physical effects prompted a rapid growth in the number of colleges admitting women, until by 1900,

80 percent of all colleges in the United States admitted women [11, 14].

The end of the nineteenth century was also the period in which graduate programs and universities were established in the United States. The first three earned Ph.D. degrees in American history were awarded by Yale in 1861 [13] and a few women were soon included among the recipients [11]. However, the majority of graduate schools did not at first admit women and the process of gaining access was a difficult one in the United States, as it was also in Europe. Even when women were admitted and completed all the degree requirements, degrees were sometimes withheld because the institution felt it inappropriate to grant an advanced degree to a woman [11]. However, by the beginning of the twentieth century most of the major graduate schools began granting degrees to women routinely, and the number of women with advanced degrees began to increase steadily. Margaret Rossiter has compiled data on women scientists in the period before 1920 [11] some of which are given in Table I together with the corresponding figures for the post-1920 period. Included in this table are both the distribution of doctorates awarded to women by field and the percentages of scientists who were women for various fields. There are statistically significant differences between the pre-1920 and post-1920 percentages, but the major impression made by these data is that they are very similar in magnitude and in pattern. There has not been much change since 1920.

Although more than two thirds of the doctorate women in the Rossiter sample received their degrees from well-known universities (University of Chicago produced 20 percent of all women doctorates in this study), the women's colleges were at first the main employers of women scientists [11]. The percentage employed at coeducational institutions rose from 43 percent in 1906 to 64 percent with 20 percent in the state universities in 1921 [11]. However, this expansion of opportunities did not continue. For example, in 1928-29 11 percent of the active faculty of the departments natural and social sciences at the University of California (Berkeley) were women [16]. The number of women on the faculty of these departments remained between 13 and 16 through the succeeding decades, but, because of the expansion of the university, the percentage dropped steadily to 2.1 per cent in 1968-69 [16].

The pattern of increasing participation by women up to the Thirties, followed by decreasing percentages, is a general one. Figure 1 gives the average numbers per year and percentages of research doctorates awarded to women by field and decade of doctorate. For all four fields shown the percentages decrease from the 1920's to minima in the 1950's and then start to increase again. The average numbers of women per year increase from 1920 to the present, except that those for the physical and life sciences are slightly lower in the 1940's than in the 1930's. Solomon has presented the data on doctorate production as percentages of the average annual number of baccalaureates and first professional degrees granted in the

period three to ten years previous to the doctorate. For women this percentage shows no general increase from 1911 until 1960, although it varies between 0.5 and 1.3 per cent in this period, but from 1960 to 1970 it climbs steadily from 1 percent to 2 percent. For men, however, there is a general pattern of increase from 1.8 percent to 8.8 per cent for the whole period, 1911 to 1970, although there are also substantial variations around this pattern [18].

One may speculate on what were the reasons for the end of increasing participation by women around the 1920's. Prior to this the increase of the numbers of women in science had been part of a general increase in the participation of women in activities outside the home. First abolition, then suffrage, settlement house work, women's clubs, missionary work, etc, a considerable variety of mainly volunteer work enlisted the efforts of women determined to participate in our society. Some of these were part of the first wave of feminism which began in 1848 at the Seneca Falls Woman's Rights Convention organized by Lucretia Mott and Elizabeth Cady Stanton [12], but by no means a majority. However, many were very dedicated in their endeavors, some to such a degree that they prefered not to marry. This was true of most of the women scientists in this period, such a career seeming incompatable with matrimony. The attainment of women's suffrage and the more materialistic concerns of the 1920's changed this pattern and dedication was no longer fashionable. Then in the 1930's, the depression probably

limited the number of women attending graduate school more severely than was the case for men, since the education of women was not viewed, in general, as an economic necessity. In the next decade, the Second World War continued to impose such limits, and then the post-war back-to-the-home movement curtailed it even more severely. In the late 1940's and the 1950's there were two waves of veterans coming through the graduate schools, resulting in the observed percentage minima even though the number of women doctorates had increased in all fields. Since that time there has been a significant increase in both the number and percentage of doctorates awarded to women, an increase which is continuing in the 1970's. These increases certainly are due in large measure to the second wave of the feminist movement and to the changed role of women in our society. Probably the post-Sputnik surge in science also contributed and, in my opinion, so did the perception that there is now a closer approach to equality of opportunity for women and men scientists and engineers.

1973 Profile of Doctoral Women Scientists

NAS-NRC 1973 Survey of Doctoral Scientists

A survey of doctoral scientists and engineers in the United States was carried out in 1973 by the NAS-NRC under the sponsorship of the National Science Foundation (NSF). This survey was based on the Roster of Doctoral Scientists and Engineers which includes 99 percent of individuals who received science or engineering doctorates between January 1, 1930 and June 30, 1972

in the United States, and ∿ 67 percent of individuals with foreign doctorates working in the United States. A third group included in the survey were individuals with research doctorates in other fields who were employed in science or engineering areas, and for this group the completeness of the sample is not known. However, the foreign doctorate and the non-science doctorate groups together contained less than 5 percent of the total number of doctorates and therefore the uncertainties concerning these groups are not important. The survey sample of 59,086 individuals was selected from the total population of 272,200 using a variable sampling technique designed to permit reliable observations on small groups within the total population, thus making possible this study of women. The statistics available from this survey represent the whole population because the numbers obtained from the sample were weighted by the known sampling ratios for the given categories. For further details on the Roster, the sampling and the weighting procedure, the reader is referred to "Doctoral Scientists and Engineers in the United States - 1973 Profile" [19].

The survey included questions on a variety of topics, most of which will be covered in the ensuing discussion. The information permits a categorization of the individuals responding either by field of doctorate or by field of employment. Both of these have been used where appropriate in this study. The respondants were asked to designate these fields from a choice of approximately 150 specialties in science and engineering grouped into the following eleven fields: 1) mathematics,

2) astronomy, 3) physics, 4) chemistry, 5) earth, environmental and marine sciences, 6) engineering, 7) agricultural sciences, 8) medical sciences, 9) biological sciences, 10) psychology and 11) other social sciences. However, throughout most of this study a coarser grouping has been used to preserve statistically significant sample sizes and to reduce the amount of tabular information where warranted. This is a division into four broad fields, physical sciences (1 to 5 of above), engineering, life sciences (7 to 9 of above) and social sciences (10 to 11 of above). Although this grouping does not permit observation of the differences between fields, it permits significant sample sizes for three of the four fields listed, but not in general for engineering. The number of women in the sample of doctoral engineers is very small and the results presented for this group are intended only for qualitative comparison. The numbers and weighted numbers of the women included in this study are given in Table II to indicate the sample sizes and weighting factors.

Since the questionnaires included identification of race and ethnic background of the respondent, it was possible to examine the differences between women doctorates from different racial and ethnic groups. There are some uncertainties introduced by an incomplete sampling on these questions and a low (70 %) response rate on the question concerning ethnic background. The reliability of these data and a discussion of the results for minority groups are given in "Minority Groups Among United States Doctorate Level Scientists, Engineers, and Scholars, 1973" [20].

Distribution by Field and Other Characteristics

Table III gives the percentage of doctoral scientists who were women for the various broad fields and fields of the doctorate degree. Also shown are the number of subfields in each field and those subfields which either had a significantly ($P<0.1\%$) [21] higher or lower percentage participation by women. Forty-six or 28 per cent of the 167 subfields had a percentage participation by women which was significantly different from that of the corresponding field. It is interesting that ecology and food science and technology, fields in which women pioneered [22], had a lower participation by women in 1973 than other subfields of the biological sciences.

Figure 2 gives the percentage distribution of women and men doctorates by the decade in which they received their degree. A significantly larger percentage of the women received their degrees in 1930-39 and smaller percentages, in 1950-59 and 1960-69 than was the case for the men. This pattern is also observed individually for the doctoral broad fields with an expecially large percentage of women in the physical sciences having received their degrees in 1930-39 ($10.1 \pm 0.5\%$ vs. $6.7 \pm 0.3\%$ for men in the physical sciences). Table IV gives the percentages of doctoral scientists who received their degrees in fiscal years 1970 through 1972 for the various fields of doctorate. Except for those with non-science doctorates, the percentages for women are significantly larger than those for men and 24 percent to 35 per cent of women doctorates in 1973 had received their degrees in this period. This is of course a consequence of the sharp

increase in doctorates granted to women shown in figure 1.

Table V gives the percentage of women doctoral scientists by racial categories and the corresponding percentages for men. The last column gives the percentage of women in each category and the uncertainty of these percentages. The percentage of women in the Black/Negro category is greater ($P < 1\%$) than the percentage of women in the total sample and the percentage of women in the East Indian category is less ($P < 1\%$). Similar differences are observed for all fields for both categories, although with a subdivision of the data by doctorate field the differences are no longer statistically significant. The data for the American Indian category are not shown separately because of inadequate statistics. Table V also gives the corresponding percentages for various ethnic categories. Only the percentage of women in the Afro American category is different ($P < 1\%$) from that for the total sample.

Turning to the question of country of origin, Table VI gives the percentage of doctoral scientists who were foreign born. A greater percentage ($P < 1\%$) of women in the physical sciences, engineering and the life sciences were foreign born than was the case for men, and a lesser percentage ($P < 10\%$) of women in the social sciences. In the other three categories no significant difference is observed. Only in the case of engineering is the difference striking. Table VII shows that the percentage of both women and men doctoral scientists with foreign doctorates is small. The percentage of women with foreign doctorates in the physical sciences is significantly

($P < 10^{-3}\%$) less than the percentage for men. In the other fields there is no significant difference. There is a difference between the temporal pattern for the percentage of women scientists with foreign doctorates and that for men in that more ($23.4 \pm 1.5\%$) of the women with foreign doctorates received them before 1950 than was the case for men ($18.5 \pm 0.6\%$).

Table VIII shows the distribution by field of employment of the women and men from the various doctoral fields. The percentages of women who were employed in the same field as that in which they received their doctorate are significantly lower than the corresponding percentages for the men. This difference has an important contribution due to the larger percentages of women than men in the "not employed" category, but there are other significant differences. For example, the percentage of women with doctorates in the physical sciences is found to be significantly less for employment in engineering than is the case for men, and significantly more for employment in the life sciences. More women than men with engineering degrees and fewer with degrees in the life sciences and non-sciences were employed in the physical sciences. For both women and men the majority of the scientists with non-science degrees were working in the social sciences.

Table IX gives the composition of the four scientific fields of employment in terms of doctoral field, and a few differences are observed between the percentages for women and those for men. The percentage of women employed in engineering who have doctorates in the physical sciences is nearly twice that for men,

and the percentage of those women who have doctorates in engineering is much less than the corresponding percentage for men. The percentages of women employed in the physical sciences who received their degrees in the life sciences or non-sciences are twice those for men. A detailed discussion of the field mobility of the doctoral scientists and engineers may be found in reference 18.

Employment Status

Table X gives the 1973 employment status of women and men doctoral scientists by decade of doctorate as well as for the total samples. The percentages of women who were working full time are considerably less than those for men in all decades, whereas the percentages of women who were unemployed and seeking employment are significantly greater. The percentages of women who were part time employed are approximately constant with decade of doctorate, whereas the percentages for men increase from a factor of ten lower than those for women for recent doctorates to equality for the oldest group. The percentage of women who were unemployed and not seeking employment also remains relatively constant, and neither this nor the part time employment shows a marked increase for women in the groups who might be expected to have been caring for young children.

There is a significant difference in employment pattern for the different racial categories. Eighty-four percent of the women who designated themselves as Black/Negro were in post-doctoral positions or full time employment, a result which is

statistically significantly ($P < 1\%$) different from the results for White/Caucasian (69%), Asian (69%) and East Indian (66%) women. The numbers of women in the other employment categories were generally too small to permit any analysis, the exception being that there were significantly ($P < 10^{-2}\%$) more Asian than White/Caucasian women in post-doctoral positions (10% vs. 4%) and among those who were unemployed and seeking employment (11% vs. 3%).

The distribution by employment categories for the various doctoral fields is given in Table XI. Although there is variation from field to field, the qualitative pattern remains the same. One of the larger differences is that significantly ($P < 10^{-2}\%$) more women worked part time in the social sciences than in the total sample and fewer, in the life sciences. The percentages of women who were in post-doctoral positions are approximately twice those for men in all fields, but there is a variation between fields with the percentages being largest in the life sciences and smallest in the social sciences. For the three categories unemployed-seeking, unemployed-not seeking and retired, the physical science percentages are significantly larger than those for the total sample, while these social science percentages are lower ($P < 1\%$).

Table XII gives the percentages of employed women and men in the three employment categories for the various fields of employment. The patterns are similar to those observed in Table XI which included all doctorates and where the categorization is by field of doctorate. Part time employment was

significantly higher ($P < 0.1\%$) in the social sciences than in the total sample, and the field of psychology contributed heavily to this (22.0%) of employed women psychologists worked part time vs. 12.9% of employed women in the other social sciences). There is also a wide spread in the percentage of employed women who work part time in the physical sciences, with the largest percentages in physics/astronomy (19.4%) and earth sciences (18.9%) and the lowest in chemistry (15.2%) and mathematics (13.7%). Excluding engineering, the lowest percentage of part time employment occurs in the life sciences (10.9%) which is significantly ($P < 10^{-4}\%$) less than that for the total sample.

The NAS/NRC questionnarie asked the individuals who were employed part time in 1973 whether they were seeking full time employment. Twenty-three percent of the women and 31 percent of the men responded affirmatively. There was however a strong dependence of this response on time elapsed since receiving the doctorate, the results for which are shown in Figure 3. The percentages decrease from high values for recent Ph.D.'s for both sexes, but more than twice as steeply for men. There was also a variation in the response for various doctoral fields and this is shown in Table XIII. It is evident that in the two physical science fields where a larger percentage of women worked a part time, physics/astronomy and earth sciences, this occured least by choice, whereas in psychology, where again a larger percentage of women worked part time, it was significantly ($P < 0.1\%$) more by choice, than for the women in all fields.

Also shown in Table XIII are the percentages in each field who were either working part time and seeking full time

employment or unemployed and seeking employment. For women these percentages range from a high value in physics/astronomy to a low value in mathematics, excluding the non-science doctorates. The percentages for women range from two times higher (mathematics) to eight times higher (earth sciences) than those for men.

The NAS/NRC questionnaire also asked those an a postdoctoral appointment what was the most important reason for accepting that appointment. The majority of both women and men selected the reply "sought additional research experience in field" (respectively 52 percent and 44 percent). A significantly ($P < 0.1\%$) smaller percentage of women (30%) than men (38%) selected the reply, "employment position not available". Thirteen percent of both sexes selected, "opportunity to change to another field", and 5-6 percent, "other", or did not reply. There was, however, a dependance on time elapsed since receiving doctorate, with 38-40 percent of both women and men post doctorates who received their degrees before 1970 selecting: "employment position not available".

The NAS/NRC questionnaire asked the employed respondents to specify whether or not they were in a science or engineering related position. Table XIV gives the percentages from the various doctoral fields of those who were employed in non-science/non-engineering positions and it is seen that the percentage of full time employed women in such positions is 55 percent larger ($P < 10^{-6}\%$) than that for men. This difference exists in the physical and life sciences, but not in the social sciences. In part time employment,

however, the situation is reversed and the percentage of women in non-science/non-engineering positions is 37 percent less ($P < 0.1\%$) than that for men. The difference exists to some degree in all three fields.

The individuals who indicated non-science/non-engineering employment were asked to specify reasons why they were in such employment. The response rate to this question was poor; less than 40 percent of both men and women selected one of the five reasons given. Of those who did, nearly 50 percent of the women and 40 percent of the men selected: "Prefer non-science or non-engineering position". Approximately 30 percent of each sex selected: "promoted out of science or engineering position" and 14 percent, "Science or engineering position not available".

Employer and Primary Work Activity

Table XV gives for each field of employment the percentage of women doctorates who were employed full time by the various types of employer. Colleges and universities are seen to have employed the majority of doctoral women in all fields except engineering in percentages ranging from 53.3 percent for chemistry to 85.3 percent for mathematics and social sciences other than psychology. The percentages employed by other employers are in general small, except those for women chemists and engineers employed in business or industry. The relatively large percentage of women employed in psychology who gave an employer in the "All other" category were mainly employed at a hospital or clinic.

Table XVI gives for each field of employment and employer the percentage of all full time employee doctoral scientists who were women. The percentages of those employed in other educational institutions (secondary schools, junior colleges, community colleges, technical schools, etc.) who were women are higher ($P < 1\%$) than the corresponding percentages for all employers, and the percentages for those employed in business and industry, significantly lower. The exceptions to this were earth sciences and engineering where the differences are not significant because of the small sample sizes.

Figure 4 shows the percentages of women and men full time employed in the physical sciences by a given type of employer with a particular primary work function. Both men and women are seen to have been predominantly in teaching at four year colleges and universities, although the percentage for women (51.1%) is significantly ($P < 10^{-2}$) higher than that for men (35.0%). These percentages also vary considerably by field, from 72.3% and 57.5% for women and men, respectively, in mathematics; 42.7% and 25.3% in chemistry; 38.8% and 33.4% in physics; to 29.8% and 30.2% in earth scineces. In both business and industry and the federal government, the women doctorates were less represented in management and administration relative to research than was the case for the men.

Figure 5 gives the percentages of women and men doctorates full time employed in the life sciences again by employer and primary work activity. As in the physical sciences, the category with the largest population was teaching at four year colleges and universities, but the percentage for women (35.6%)

is much less than in the physical sciences and not very different from the percentage for men(30.8%). The percentages of those whose primary work activity was research at colleges and universities are 26.3% and 21.4% for women and men, respectively. The percentages of women whose primary work activity was management and administration are less than those for men for all employers, but this is especially marked in business and industry.

Figure 6 gives the percentages of women and men full time employed in the social sciences again by employer and primary work activity. The largest percentages of both women and men were in teaching at four year colleges and universities (48.4% and 51.0% for women and men, respectively). The percentages are similar and considerably higher than those in the life sciences and that for men in the physical sciences. There are considerable differences between psychology and the other social sciences in this respect. 36.1% and 36.9% of the women and men doctorates full time employed in psychology, respectively, were in teaching at four year colleges and universities, whereas this was true for 67.9% and 62.8% of the women and men in the other social sciences, respectively. The fairly substantial percentages for those who gave a primary work activity in the "All Other" category were predominantly doctorates employed in psychology whose primary work activity was professional service (61.0% of the women and 41.9% of the men). Similarly many of those who gave an employer in the "All Other" category were psychologists working in hospitals or clinics (52.5% of the women and 41.5% of the men).

Table XVII gives the percentages of part time employed doctoral women scientists in given fields of employment for the various types of employers. A larger percentage of those in physical sciences were employed at four year colleges and universities than was the case for full time employment, whereas in the social sciences, the reverse was true. Table XVIII gives the percentages of part time employed doctoral scientists in given fields of employment and for various types of employers who were women. The doctoral women were in the majority among those doctoral scientists part time employed at educational institutions other than four year colleges and universities. In psychology, the doctoral women were in the majority among those part time employed except in business and industry and non-profit organizations.

Figure 7 shows the distribution of part time employed men and women doctoral physical scientists by employer and primary work activity. The women were mainly in teaching and research at four year colleges and universities, whereas the men were mainly in research at those institutions. Figure 8 shows the equivalent distribution for the life sciences and here both men and women were mainly in research at four year colleges and universities, although 13.2% of the women gave teaching as their primary work activity at those institutions. Figure 9 shows the distribution for the social sciences and sizeable percentages of both men and women are in the employer category, "All Other", and also "All Other" for primary work activity. These were predominantly psychologists who gave sale of professional services

as their primary work activity, many of whom (57.4% of the women and 50.8% of the men) worked in private hospitals and clinics. Of all part time psychologists, irrespective of employer, 45.6% of the women and 38.6% of the men gave sale of professional services as their primary work activity.

Four Year Colleges and Universities

Since such a large percentage of the doctoral scientists work at four year colleges and universities, it is interesting to consider this group further. Table XIX gives the percentage of doctoral scientists full time employed at such institutions by field of employment and academic rank who were women. The pattern is the same for all fields; the percentage of professors who were women is less than that of assistant professors. This is an observation that has been made in all studies of academic women. It should be noted that mathematics which had a relatively high percentage of professors who were women, is a field in which academic women predominantly gave teaching as their primary work activity, unlike physics where the division between teaching and research was similar for women and for men and where the percentage of professors who were women is relatively low. The category "Other/No Report" includes instructor, lecturer, other and no report. The numbers in these categories are too small to warrant including them separately, but it should be pointed out that 20 per cent of all instructors and lecturers were women.

Table XX gives the percentage of women doctoral scientists full time employed at four year colleges and universities in each given field of employment by academic rank. The differences in the percentages between professor and assistant professor are less marked than those in Table XIX. This is a reflection of the current situation at most academic institutions where finances have caused a decrease in the number of assistant professors appointed, but have not affected the tenure positions. The category "Other/No Report" for all fields includes 0.9 percent instructors, 1.2 per cent lecturers, 5.9 other and 3.0 percent no report.

Table XXI gives the percentage of doctoral scientists part time employed at four year colleges and universities at a given rank who were women. Approximately half in each category were women, except that of professor, where the women were strikingly absent, and that of instructor, where there were only women. The percentages for the various fields of employment agree with those for all fields within their large statistical uncertainties.

Table XXII gives the distribution of doctoral women scientists full time employed at a given rank by decade of doctorate. Table XXIII gives the percentage of doctoral scientists in each rank from each decade of doctorate who are women. The percentage of professors who were women is quite constant for all the decades, but both the associate professor and assistant professor ranks included larger percentages of women who received their degrees less recently. In the case of the instructors, a comparison of

the percentage for all decades with that for > 69 indicates that here again there are more women instructors with less recent doctorates.

Salary

A final question that can be examined using the data from this survey, is that of relative salaries. Figure 10 gives a curve taken from "Doctoral Scientists and Engineers in the United States--1973 Profile" [19], which shows the median annual salaries of doctoral scientists in 1973 by age for men and women separately. The difference between the sexes is quite dramatic and increases with age. Table XXIV gives the median salaries for full time employment of women doctoral scientists for various fields of employment and employers and also the percentage differences from the median salaries of men in the given categories. For all fields together the biggest differences in median salary are observed for the non-profit institutions and the smallest for the federal government. The only category for which the median salary for women was greater than that for men is that of engineers employed by the federal government.

Table XXV gives the median salaries of women doctoral scientists full time employed at four year colleges and universities in the various academic ranks for each decade of doctorate, and also the percentage difference of the median salaries of men in the same categories. For the professors, the difference in median salary increases with decade of doctorate as it does for the total sample. This pattern is not seen for the assistant

professors where the difference is greater for those who received their doctorates since 1969 than for those with less recent degrees. The rank of instructor is the only one where the median salary of the women was higher than that of the men, and a comparison of the difference for all instructors with that for those who received their degrees since 1969 indicates that the women who received their degrees before 1969 have even higher salaries relative to the men.

Discussion

The 1973 profile of doctoral women scientists presented in the previous section shows, as have previous studies, that women doctorates are represented in very small percentages in engineering and the physical sciences. The percentages are somewhat larger in the life sciences and social sciences, but even in the social science with the largest participation by women, psychology, this percentage was only 20 percent. Furthermore, it has been seen that in aggregate they achieved less than men in terms of position and salary, and suffered a higher involuntary unemployment rate. Their employer and primary work activity patterns were different from those of men. The possible causes of these differences may be grouped into four general and not completely distinct categories: sex differences in scientific aptitude, cultural barriers, discrimination and dual career problems. These will be discussed briefly in this section, which will close by an assessment of recent trends and what they may predict.

Sex Differences in Scientific Aptitude

The idea of innate and unalterable sex differences that affect the aptitudes of the sexes for various professions is a very pervasive one which is supported by occasional popularizations of "scientific" evidence [25]. There are certain widely held ideas concerning areas of difference, and in the past it has been difficult for a non-specialist to assess the validity of any of these due to an inadequate knowledge of the complete experimental picture. There is now an encyclopedic compilation and discussion of the results of such research by Maccoby and Jacklin [26], which makes possible a clear understanding of what is myth, what is fact, and what has not yet been established. This section relies heavily on the interpretation of these authors, but simply because in most instances it seems amply borne out by the data. However, some additional comments are in order. The first of these is that the tabular arrays of experimental results presented in this book strongly make the point that the result of a single experiment, or those of a small group of experiments, are never adequate to yield a definitive answer to any general question. The sample choice, the experimental technique and the interpretation of what is measured permit contradictory results for any attribute studied. However, certain patterns do emerge, and some of them are very relevant to the present discussion. Maccoby and Jacklin conclude that evidence indicates an absence of sex differences in eight attributes where they are commonly thought to exist. Of

these, the following three are most pertinent to the question of scientific competence. 1)"---girls are better at rote learning and simple repetitive tasks, boys at tasks that require higher-level cognitive processing and the inhibiiton of previously learned responses", 2) "---boys are more analytic". 3)"---girls lack achievement motivation". There is an accumulation of experimental evidence which disproves these stereotypes. In seven other areas Maccoby and Jacklin concluce that the evidence is insufficient to decide on the question of differences, among which the following are most relevant to this discussion. 1)competitiveness, 2) dominance, and 3) compliance. In the remaining four areas Maccoby and Jacklin conclude that fairly well established sex differences exist. These are the following: 1) "---girls have greater verbal ability than boys", 2) "---boys excel in mathematical ability, 3) "---boys excel in visual-spatial ability, and 4) "---males are more aggressive" [27]. For both of the first two abilities no differences are observed between boys and girls in the period from preschool to early adolescence, but significant differences are observed for older groups in the U.S.A. Available evidence does not indicate a genetic component for either of these abilities [28]. The magnitude of the sex difference in mathematical ability varies widely, depending on the group studied, and the differences of the means on the relevant test scores are less than 0.4 of a standard deviation [27]. It should be pointed out that sex differences in mathematical ability apparently are not observed for adolescents in the U.S.S.R., possibly as a consequence of the societal

acceptance of scientific and technical careers for women [29].

There remain the differences in visual-spatial ability and aggression, both of which Maccoby and Jacklin conclude have a genetic component. The question of aggressiveness is not necessarily correlated to scientific competance since as defined it does not include achievement motivation, competitiveness and dominance. Furthermore, as Maccoby and Jacklin point out, aggression also has an important learned component and is negatively correlated with intellectual ability in boys (however positively, in girls). Therefore, the male biological priming for learning aggressive behavior does not appear to be a positive factor for a career as a scientist. However, it seems intuitively obvious that there should be a correlation between visual-spatial ability and the aptitude for the physical sciences and engineering, although there is no evidence for the degree of correlation or even for its existence. Therefore, it is relevant that one gene which contributes to high spatial ability is sex-linked and that 25 per cent of females and 50 percent of males have a contribution of this genetic element. It is interesting that this gene is associated with cross-sex typing, that is with low "masculinity" in males and high "masculinity" in females [30]. There are also other genes contributing elements to visual-spatial ability which do not appear to be sex-linked, and, furthermore, there is an important learned component in the exercise of these abilities. The relative importance of the latter is evident in the wide variation in sex differences

between cultures [28]. The differences observed are in general less than 0.4 of the standard deviations [27]and thus the overlap of the male and female populations is much greater than their difference. It is not possible to assess what the relevance of this information is to the participation of women in science and technology, but it does make clear the necessity for an educational process which stresses development of the visual-spatial abilities equally for boys and girls.

Cultural Barriers

It is unnecessary to provide documentation for the fact that science and technology have been considered inappropriate careers for women in our society, so ubiquitous has been this belief. The first effects are observed at the secondary school level in the U.S.A. where the percentage of girls participating in mathematics and science courses decreases sharply with the level of these courses and has as its consequence a low participation of women in undergraduate science and engineering majors. This may be contrasted with the USSR where participation of women in all fields is encouraged and where approximately half of the science and engineering stduents at these levels are female [29].

A second consequence has been that a significantly smaller percentage of women entering graduate school in the U.S.A. continue to a doctorate degree than is the case for men [10,18]. This is at least partly due to the fact that in the past women

have terminated graduate study with a master's degree in percentages, twice as big as those for men [31, 32]. One interesting consequence of this successive winnowing of the women has been, understandably, that on the average the women who completed doctorates were of significantly higher quality than the men as measured by ratings at secondary school level [33] and on standardized graduate school admissions tests [10]. In fact, Harmon has pointed out that with respect to the secondary school predictors the ordering at the doctorate level was married women, single women, single men and married men [33]. This must contain a strong component due to the belief that inappropriate as a scientific career is for a single woman, it is significantly more so for a married woman. Thus, those needing the most determination to succeed were in fact more highly ranked on the average and this agrees with a point mentioned in the previous section that intellectual ability is positively correlated with aggressiveness in girls.

A second cultural barrier of major importance is the belief that women are less competant as scientists [10]. The impact that this belief could have on a woman contemplating such a career could be severe. Several authors (e.g. Graham [6]) have suggested that this is acerbated by the sparcity of women scientists to serve as role models. Another component is very probably a fear of competence, akin to the fear of success identified by Horner [34]. Tho other side of this quesiton is, of course, the belief by men that women are less competent, not necessarily because of innate ability, but also for a variety of other reasons.

In this period affirmative action and feminist pressure have changed these issues from academic to political. These include the belief that women doctorates are primarily produced from less-prestigious graduate schools, a belief which is not borne out by the statistics [10, 18]. Another belief was that doctoral women drop out permanently from their professions in large percentages. This was first disproved by Astin [5] and has subsequently been shown to be false in numerous studies (e.g. Simon, Clark and Galway [4]). In the 1973 profile just presented the level of this nonparticipation is seen to be 4.2% for women as compared to 0.3% for men ("not employed--not seeking" in Table X). A more significant effect is the substantially higher percentage of women who worked part time (12.8% vs 1.9% for men). However, surveys have indicated that part-time work frequently has occured for only a fraction of the duration of a given career [4,5,31], and the effect on over-all scientific performance is only a matter of hypothesis. There is, finally, the belief that women are better at teaching than research. The 1973 profile and other previous studies certainly show that women in the physical sciences list teaching as their primary work activity in substantially larger percentages than is the case for men, and that this is only partly due to the fact that larger percentages of women than men are employed in institutions where research is difficult or impossible [4,5,9,35]. Nevertheless, in the Centra study approximately the same percentage of women and men indicated a primary interest in teaching (32% vs 26%) [9]. However, in the aggregate women publish fewer papers than

men even when only individuals at similar institutions are compared [9, 10,35]. The disparity is least in the colleges and greatest in the universities and increases with length of full-time employment [9]. Since the number of publications of a given individual depend on research support, as well as on teaching load, and none of the studies done so far have controlled for such factors, these differences are not yet understood. In fact, given the small size of the sample of woman scientists it is not clear that such a study would produce a significant result. Thus we are left with a pattern of productivity that mirrors the respective employment patterns of women and men, and which may or may not have an additional sex-based component [2]. To underscore this uncertainty it is interesting to note that in one study a group of women scientists were found to have a higher publication rate than a matched group of men [4].

Another barrier which is frequently mentioned is the lack of colleagial interaction, particularly in the physical sciences and engineering where women are so much in the minority [2,5-7]. Frequently, this is unintentional, the result of a pattern set up by an all male group of colleagues which does not accommodate itself easily to the inclusion of a new female colleague. Sometimes it is institutional, for example a faculty club which does not admit women except as visitors. Occasionally it is deliberate, and the justification is freedom in the choice of one's associates. But in addition to causing deprivation of informal channels of scientific communication, a lack of ordinary

colleagial interaction makes the point that the individual in question is regarded as woman rather than as scientist. The blighting effect of such an environment on even an outstanding woman scientist is made abundantly clear in Sayre's description of Rosalind Franklin's years at King's College [36].

A final barrier is invisibility, which is manifested in a variety of forms. The most prevalent recently has been, of course, the statement "We are trying to find a woman to appoint in our department, but we just can not find any who are qualified." This statement has occasionally been made even when the department contained a woman scientist in a research position whose research record was as good as many members of that department. Another form of this type of invisibility is that opinions concerning the woman's personality replace a realistic consideration of her scientific competence. An extreme example of this is apparently the description of Rosalind Franklin in "The Double Helix" [37] which, according to Sayre, attempts to denigrate her contributions to discovering the structure of DNA and to justify covert use of her results by a grossly inaccurate personal portrait [36]. Next there have been many direct manifestations of invisibility, such as being overlooked for committees, meetings and honors, but the recent climate of affirmative action does seem to have made at least token improvements in this area. A final example of invisibility must suffice, although the list given here is far from exhaustive, and this is the scientist who is given insufficient credit because she has a male colleague who, it is assumed, must have played a major

role. This is particularly true when the colleague is a husband, an outstanding example being Marie Curie, who in numerous articles on women in science is listed as a woman who won a Nobel prize jointly with her husband. What is not stated is that in addition to the 1903 Nobel prize in physics for the discovery and understanding of radio activity which she received jointly with Antoine Becquerel and Pierre Curie, she won the unshared 1911 Nobel prize in chemistry for the discovery of radium and polonium after her husband's death. This latter achievement was due to her ability and dedication [38], and she was the first individual to receive two Nobel prized until 1962.

Discrimination

The patterns observed in aggregate statistics such as those just presented in the 1973 profile are sometimes claimed to be substantiation for a pattern of discrimination. However, this is not demonstrable unless an analysis is done which controls for other factors which could enter. Cole and Cole have done an analysis of the correlation between sex status and academic rank in three scientific fields (chemistry, biology and psychology) and found a significant residual effect after controlling for quality and quantity of research [35]. They, however, believe that factors other than discrimination are responsible for this. The study of Johnson and Stafford ascribes the difference between men and women in prestige of institution, rank and salary to differences in performance as measured by publication and various forms of recognition, and of career choices

including voluntary leave for child rearing and limitation of employment to a given geographical area [39]. Strober and Questar have pointed out the circularity of these arguments and the undemonstrated assumptions on which they rest [40]. The most recent study of academic rank and salary differentials, carried out by Astin and Bayer, which uses a stepwise multiple regression analysis potentially involving 60 predictors, results in a statistically significant correlation between sex and both rank and salary. Even when the relevant predictors are controlled for, "---(this) study does show that the sex differential in salary is largest for women who have been in the system longest and achieved high rank when sex discrimination was presumably greater," [41]. It would seem that such a complete and careful demonstration of previous sex discrimination would end the discussion, but since this is an economic and political issue it certianly will be attacked on the basis that there are unmeasureable factors other than discrimination which cause the difference. There is a ready market for such arguments in those who have previously participated in discrimination and do not wish to view it as such (e.g. Lester [42]).

Irrespective of whether it is statistically demonstrable, there is an overwhelming body of circumstantial evidence that sex discrimination is at least in part responsible for the differences in the patterns for men and women scientists. This is based on an accumulation of individual experiences, an accumulation only made possible when the feminist movement brought these issues into the open. It should be pointed out that the

many male scientists who have always opposed sex discrimination are among those who contribute anecdotal evidence of its existence. Other examples range from the experience of Maria Goepper-Mayer, who was denied a paid scientific position for many years and did not receive a full-time professorship until after the publication of her Nobel prize (1965) winning work on the nuclear shell model [43], to that of a Ph.D. whose advisor suggested a job as a scientific editor because it was more compatible with marriage and a family than a research position.

Dual Career Problems

There remains one cultural barrier to equal participation by women in science and technology, and this lies in the practical problems of combining such a career with marriage and children. This appears to be world wide [44]. In the USSR, where there is very little differentiation between the sexes in either treatment or performance through the first level of university, there is a steady decrease of the percentage of women with the level of achievement. For example, in 1961 8 percent of the professors, 18 percent of the associate/assistant professors, 29 percent of the senior assistants and 51 percent of other assistants in scientific work were women [45]. In 1962-64 17 percent of those receiving candidate (Ph.D.) degrees and only 8 percent of those receiving doctorate (advanced doctoral) degrees in physics and mathematics were women [45]. This has been ascribed by several authors to the unequal burden carried by Soviet women in the care of household and children [45,47,48].

Although there is some anecdotal evidence that other factors such as discrimination may contribute [49], it is obvious to anyone who has visited the USSR that even with day care centers the effort of caring for a family is far from negligible.

Evidence for an effect of marital commitment could be observed in terms of differing publication rates. In the Centra study a greater publication rate was observed for single women than for married women [9], but in that of Simon, Clark and Galway, there was a trend in the opposite direction [4]. Cole and Cole found no correlation with marital status, but a decrease in publication rate for women with more than three children compared to those with fewer [35]. An informal survey of outstanding women scientists discloses that a substantial proportion of them now have families, unlike the situation fifty years ago when the majority were unmarried. In the absence of a careful study of the correlation of success and marital status, one must rely on the impression created by a number of surveys [2,5,10,31] that women scientists have not infrequently accepted less demanding careers because of their roles in their marriages. This has included a willingness to put their husband's career first, to move to areas where there were no or inferior job opportunities, to assume the major share of household labor and the responsibility for children, and to choose teaching over research because it meshed better with their family duties.

Recent Trends

In recent years there has been a significant increase in the percentage of doctorates awarded to women. As can be seen from Figure 11, this is partially due to the fact that the number of doctorates awarded to men has decreased in all fields except the social sciences, but it is also due to increases in the numbers of doctorates awarded to women. These trends are also observed in a recent study of graduates from universities which are members of the American Association of Univerisities (AAU) [50]. Table XXVI gives percentages computed from the data on the AAU universities and those for all doctorate granting institutions [24]. Since the time periods covered are not identical, no interpretation can be made of the differences in percentages. This increase in doctorates is partially due to a 25 percent increase in the percentage of woman baccalaureates who entered graduate school in all disciplines between the early 1960's and the late 1960's [51]. It is also due to an $\sim$ 10 percent increase for all doctoral fields in the percentage of women entering graduate school who subsequently received a doctorate [51]. Both of these trends can probably be attributed in major part to the changing view of the role of women in our society and also to the perception, true or not, that opportunities for doctorate women commensurate with their education are more readily accessible.

A significant difference between women and men in the average duration of graduate studies and the average age at the receipt of the doctorate has been observed previously. Both in

the group of all doctorates prior to 1963 [33] and in the selected group in the Centra study [9], the women received their degrees at a median age one to four years greater than that for the men in the corresponding fields with a correspondingly greater time interval between the receipt of the baccalaureate and that of the doctorate. Centra points out that for the two groups in his study (doctorate received 1958-59 and 1968-69) this was the consequence of a much narrower age distribution for men than for women, with higher percentages of women having received their doctorates before the age of 25 and after that of 43 years [9]. Table XXVII indicates that these patterns have changed for recent doctorate recipients. The differences between the median age, the median length of graduate study and the median lapse between baccalaureate and doctorate have all disapppeared. A major difference which remains is that of the percentages of doctorate recipients who were married with 56 percent of the women married for the whole three year period and 73 percent of the men. However, there appears to be decline in the percentage of those married for both sexes. Again, these are trends mirroring our changing social patterns.

Another change that appears to have taken place is in the pattern of first job placements. Although doctorate women in the age group corresponding to first employment still suffered from higher involuntary unemployment in 1973 according to the data presented in this paper, they also appeared to be making gains in some respects. As pointed out by Cartter and Ruhter, the percentage of new doctorate women teachers hired by

universities in all disciplines between 1967 and 1973, remained approximately constant, whereas the percentage declined for all new doctorate teachers. In that period there was an increase in the percentage of new male doctorate teachers in four-year colleges, two-year colleges, and elementary or secondary schools, whereas only in the two-year colleges was there an increase for new female doctorate teachers [51]. A survey of doctoral physicists found that the percentage of assistant professors at universities who were women doubled between 1971-72 and 1974-75, and that in the top ten physics departments this percentage increased by a factor of six. However, the percentage for professors at all four-year colleges and universities decreased by 17 percent and that for associate professors stayed constant [52]. Furthermore, Bayer and Astin pointed out that at the most junior levels the sex correlated differential in salary disappeared in 1972-73 [41]. Thus in the universities there has been a percentage increase of women on the junior faculty at apparently equivalent salaries to those of the men. In the Cartter and Ruhter study of all doctorates, it was observed that in 1973 a slightly higher percentage of women were employed in teaching or research at institutions equal or superior to their degree granting institutions than was the case for men, whereas the reverse was true for 1967 [51]. In this period there was also a shift in employment pattern due to a sharp curtailment of hiring educational institutions. For doctoral women physicists the percentage employed by educational institutions decreased from 77%

to 67% between 1971 and 1973 and the percentage employed by government increased from 9% to 16%, the percentage in non-profit institutions and industry stayed approximately constant. The changes for doctoral men physicists were similar but smaller, except that the percentage in industry decreased [52].

Thus the recent picture has been one of significant increases in the percentages of doctorates who are women and in some small gains in percentages at the lowest academic ranks. These improvements have mainly occured because of the impact of the new wave of feminism and have certainly suffered from the worsening prospects for all doctoral scientists. Thus it is hard to make a prediction of the future trend in the participation of women in science. However, some general remarks are possible. It seems inevitable that the overall participation of women in the labor force in this country will increase further and that the percentages of women in what were formerly men's fields will increase. In the past there has been a negative correlation between the prestige of a field and the percentage of members of that field who were women, and it remains to be seen whether the changing patterns in our society will cause this to disappear. It is unlikely that cultural barriers will come down rapidly enough to permit a doubling of the percentages of women doctorates in the next decade and thus the percentages in the physical sciences will probably remain small. Engineering may be an exception because of the more promising employment market. It is the author's opinion that the differences in the aggregate employment, primary work activity, rank and salary differences will

decrease, but will not disappear. They will decrease because of changing attitudes and legal pressures, but they will not disappear until there is also real equality of responsibility and labor in the majority of marriages in the U.S.A. And she believes that this is unlikely to occur in the near future.

Summary

The 1973 profile of doctoral women scientists indicates a different distribution among fields than that in the profile for men. The percentages of women increased from engineering, to physical sciences, to life sciences, to their largest value in the social sciences. The percentages of women were largest in the oldest and youngest age groups and were somewhat larger for those who indicated Black/Negro and Afro-American racial and ethnic categories than for those who chose White/Caucasian. There were no important differences between the percentages for women and for men of those who were foreign-born or received foreign degrees.

Larger percentages of the women doctorates switched fields than was the case for men and larger percentages were unemployed and seeking employment. Larger percentages were working part time by choice or full time in non-science jobs. The largest percentages of women were employed in four-year colleges and universities and in the physical sciences, a larger percentages of full time employed women than men gave teaching as their primary activity. For the life sciences and the social sciences the division between teaching and research was similar for men

and women. The percentages of women at two-year colleges, secondary schools, etc., were larger than those for men and the percentages for women in industry were smaller.

There was a negative correlation between academic rank and the percentage of women for those full-time employed at four-year colleges and universities, and about half of the part-time assistant and associate professors were women but nearly none of the professors. The median salaries for women were lower than those for men and the difference increased with age.

This 1973 profile described a group of women doctorates who received their education after the first feminist wave broke in the 1920's. Many of them married and had families and assumed a major share of the labor and responsibility for household and children. There have been cultural barriers to their participation in science, the widely held beliefs that science and technology are inappropriate careers for women and that women are less competent as scientists, the lack of collegial interaction, the invisibility of women and discrimination against them. There are apparently at least four verified sex differences which might affect scientific ability, two which have a genetic component, aggression and visual-spatial perception, and two which do not, verbal and mathematical ability. Aggression appears to correlate negatively with intellectual ability in males and has an important learned component for both sexes. It is not known how visual-spatial ability is correlated to scientific ability and here again there is a very important learned component. Thus there is no basis for estimating what differences

would remain with a truly egalitarian system of education and opportunity.

In recent years there has been a new wave of feminism and a rethinking of the role of women in our society. In the sciences this has led to an increase in the percentages of doctorates awarded to women and to a small improvement in the employment opportunities for recent doctorates. Sex discrimination with respect to academic salaries still continued for all but the youngest group of women in 1973. The details of what the future will bring depend on many factors, especially the employment situation for scientists and engineers. Although the pressures of family responsibilities and the continuing existence of cultural barriers will probably not allow a participation by women in science and technology at a level commensurate with the distribution of ability, in the near future, it appears that this participation will continue to increase.

ACKNOWLEDGEMENTS

The author is deeply indebted to the Commission on Human Resources of the National Research Council for providing her with the data on which this profile is based. She also thanks the Sloan Foundation for a generous grant which made possible the completion of this study.

REFERENCES

1. B. M. Vetter and E. L. Babco, "Professional Women and Minorities", Scientific Manpower Commission, Washington, D.C. (1975).

2. J. Bernard, "Academic Women", The Pennsylvania State University Press, University Park, (1964).

3. A. S. Rossi in "Women and the Scientific Professions", J.A. Mattfeld and C.A. Van Aken (editors), Massachusetts Institute of Technology Press, Cambridge, Mass (1965), 51-127.

4. R. J. Simon, S. M. Clark and K. Galway, Social Problems 15, 221 (1967).

5. H.S. Astin, "The Woman Doctorate in America", Russell Sage Foundation, New York (1969).

6. P.A. Graham, Science 169, 1284 (1970).

7. M.S. White, Science, 170, 413 (1970).

8. A.S. Rossi in "Academic Women on the Move", A.S. Rossi and A. Calderwood (editors), Russell Sage Foundation, New York (1973), Chapter 22.

9. J.A. Centra, "Women, Men and the Doctorate", Educational Testing Service, Princeton, New Jersey (1974).

10. H.Zuckerman and J.R. Cole, Minerva 13, 82 (1975).

11. M.W. Rossiter, American Scientist 62, 312 (1974).

12. "Notable American Women", E.T. James, editor, The Belknap Press of Harvard University Press, Cambridge (1974), Volume 1, 357.

13. F. Rudolph, "The American College and University", Alfred A. Knopf, New York (1962), 311.

14. M. Newcomer, "A Century of Higher Education for American Women", Harper and Brothers, New York (1959), 36.

15. "Doctorates Awarded from 1920 to 1971 by Subfield of Doctorate, Sex and Decade", National Academy of Sciences (1973).

16. Departments included: anthropology, astronomy, biochemistry, chemistry, economics, mathematics, physics, physiology and anatomy, political science, psychology, sociology, statistics and zoology.
"Report of the Subcommittee on the Status of Academic Women on the Berkeley Campus", University of California Academic Senate, Berkeley Division (1970), Table IV - 2.

17. "Summary Report 1972. Doctorate Recipients from U.S. Universities", National Academy of Sciences (1972).

18. L.C. Solomon, "Women in Graduate Education: Clues and Puzzles Regarding Institutional Discrimination", draft copy (1973).

19. "Doctoral Scientists and Engineers in the United States 1973 Profile", National Academy of Sciences (1974).

20. "Minority Groups Among United States Doctorate Level Scientists, Engineers, and Scholars, 1973", National Academy of Sciences (1974).

21. The probability, P, that an individual percentage, R_j X 100, is significantly different from a mean value, is obtained from tables for a Gaussian probability distribution. The standard deviation, ΔR_j, is given by

$$\Delta R_j = \left(\frac{R_j\,(1-R_j)}{N_s}\right)^{1/2} \left(\frac{N_p - N_s}{N_p - 1}\right)^{1/2}$$ where N_s is the sample size and N_p is the weighted sample size (population).

Here $R_j = \left(\frac{N_j^w}{N_p}\right)$, $N_p = \Sigma N_i^w$, $N_s = \Sigma N_i^w$ and N_i^s are respectively the weighted and unweighted number of individuals contained in the i^{th} category. In this paper "Significant" means $P < 0.1\%$ unless P is given explicitly.

22. R.Clark, "Ellen Swallow", Follett Publishing, Chicago (1973).

23. "Field Mobility of Doctoral Scientists and Engineers", National Academy of Sciences (1975).

24. "Summary Report 1973. Doctorate Recipients from U.S. Universities", National Academy of Sciences (1973; "Summary Report 1974. Doctorate Recipients from U.S. Universities", National Academy of Sciences (1974).

25. See for example, L.Tiger, "Male Dominance? Yes, Alas. A Sexist Plot? No. " New York Times Magazine, 35 (October 25, 1970).

26. E.E. Maccoby and C.N Jacklin, "The Psychology of Sex Differences", Stanford University Press, Stanford Cal. (1974).

27. Ibid, 349-355.

28. Ibid, 361.

29. M.P. Fogarty, R. Rapoport and R.N. Rapoport, "Sex Career and Family", George Allen and Unwin Ltd., London (1971), 79.

30. E.E.Maccoby and C.N. Jacklin, ibid, 131.

31. "Women in Physics", report of the Committee on Women in Physics of the American Physical Society, Bull. Am. Phys. Soc. II, 17, 740 (1972).

32. V. Kistiakowsky, "Women in Engineering, Medicine and Science", a report prepared for the Conference on Women in Science and Engineering, National Research Council (1973).

33. L.R. Harmon, "High School Ability Patterns", Scientific Manpower Report No. 6, National Research Council (1965).

34. M.Horner, Psychology Today 3, 36 (1969).

35. J.R. Cole and S. Cole, "Social Stantification in Science", The University of Chicago Press, Chicago (1973), Chapter 5.

36. A. Sayre, "Rosalind Franklin and DNA", W.W. Norton and Co., New York (1975).

37. J.D. Watson, "The Double Helix" Atheneum, New York (1968).

38. E. Curie, "Madame Curie", translated by V. Sheean, Doubleday, Doran, Garden City, N.Y. (1937).

39. G.E. Johnson and F.P. Stafford, The Economic Review 64,888 (1974).

40. M.H. Strober and A.O. Quester, submitted for publication in The Economic Review (1975).

41. A.E. Bayer and H.S. Astin, Science 188, 796 (1975).

42. R.A. Lester, "Artibias Regulation of Universities: Faculty Problems and Their Solution", McGraw-Hill, New York, (1974).

43. J. Dash, "A Life of One's Own", Harper and Row, New York (1973), part 3.

44. There are no studies of this problem for the People's Republic of China, but most of the visitors to that country with whom this author has spoken feel that problem still exists, although it may be disappearing.

45. M.P. Fogarty, R. Rapoport, and R.N. Rapoport, ibid 67.

46. Ibid, 59

47. G.F. Schilling and M.K. Hunt, "Women in Science and Technology: U.S./U.S.S.R. Comparisons", the Rand Paper Series P-239, Santa Monica, Cal. (1974).

48. W.M. Mandel, "Soviet Women" Anchor Press/Doubleday, Garden City, New York (1975), Chapter 3.

49. e.g. the author inquired at a conference in the U.S.S.R. why in that egalitarian society there were so few women scientists in the audience. The response from the director of the institute where the conference was held, as rendered by an interpreter, was "Woman are not intelligent enough to be physicists".

50. J.L. McCarthy and D. Wolfle, Science 189, 856 (1975).

51. A.M. Cartter and W.E. Ruhter, "The Disappearance of Sex Discrimination in First Job Placements of New Ph.Ds", Higher Education Research Institute, Los Angeles, Cal. (1975).

52. V. Kistiakowsky, "Affirmative Action", a talk presented at the Washington Meeting of the American Physical Society, (1975).

FIGURE CAPTIONS

Figure 1: The average number of doctorates awarded to women per year and the percentage of doctorates awarded to women both by field and decade of doctorate. Data from "Doctorates Awarded from 1920 to 1971 by Subfield of Doctorate, Sex and Decade [15] and "Summary Report 1972. Doctorate Recipients from U.S. Universities" [17].

Figure 2: The percentage of women and men doctoral scientists (1973) who received their doctorates in a given decade.

Figure 3: The percentage of part time employed women and men doctoral scientists (1973) who were seeking full time employment.

Figure 4: The percentage of women and men doctorates full time employed in the physical science for each type of employer and primary work activity (1973).

Figure 5: The percentage of women and men doctorates full time employed in the life sciences for each type of employer and primary work activity (1973).

Figure 6: The percentage of women and men doctorates full time employed in the social sciences for each type of employer and primary work activity (1973).

Figure 7: The percentage of women and men doctorates part time employed in the physical sciences for each type of employer and primary work activity (1973).

Figure 8: The percentage of women and men doctorates part time employed in the life sciences for each type of employer and primary work activity (1973).

Figure 9: The percentage of women and men doctorates part time employed in the social sciences for each type of employer and primary work activity

Figure 10: The median annual salary of women and men doctoral scientists (1973) as a function of age. This figure is taken from "Doctoral Scientists and Engineers in the United States 1973 Profile" [19].

Figure 11: The number of doctorates awarded to women and men per year and the percentage of doctorates awarded to women by field and fiscal year of doctorate. Data from "Summary Report 1974, *Doctorate* Recipients from United States Universities"[24]. PS - Physical Sciences, LS - Life Sciences, SS - Social Sciences, E - Engineering

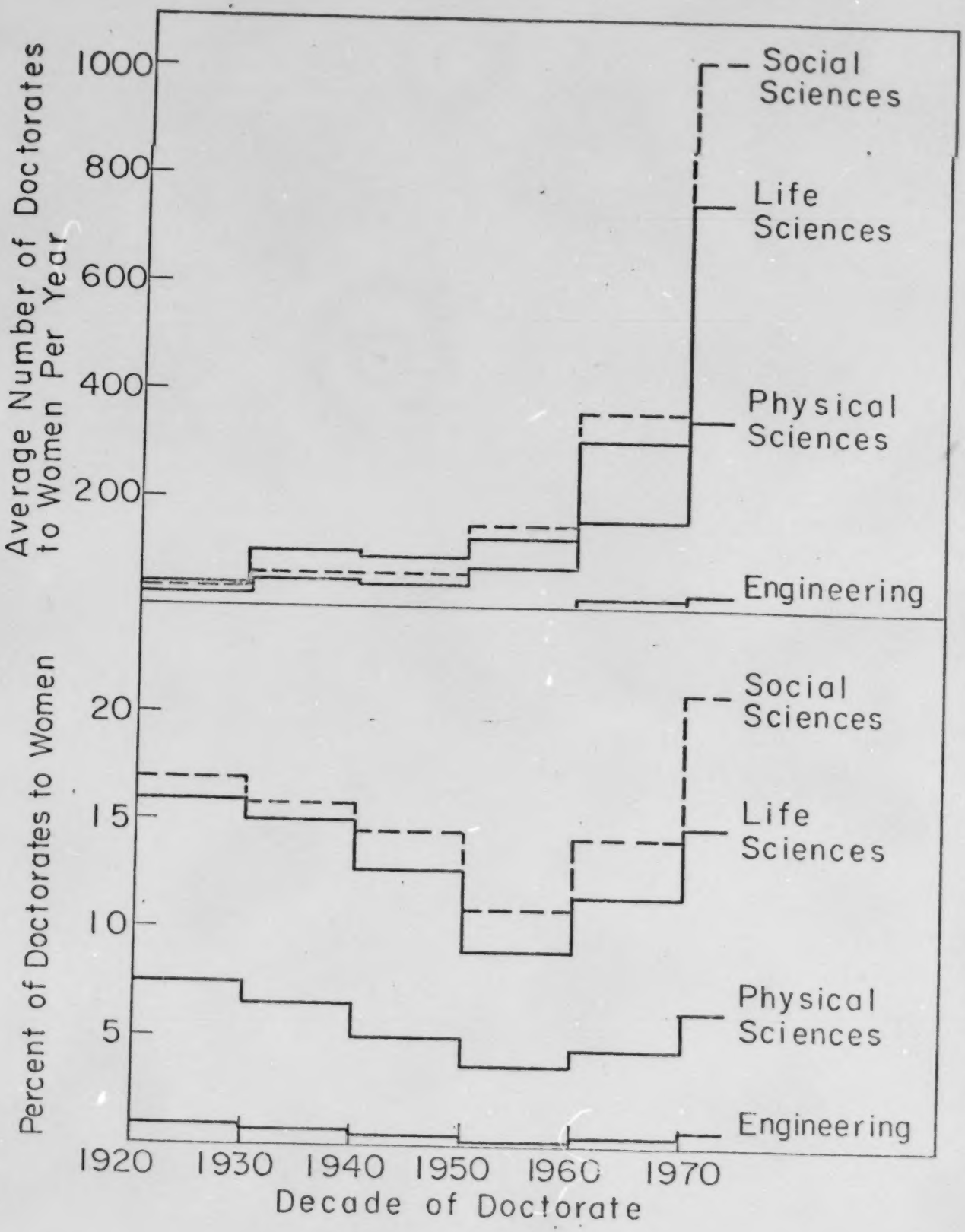

Average Number of Doctorates to Women Per Year
1000
800
600
400
200
Social Sciences
Life Sciences
Physical Sciences
Engineering
Percent of Doctorates to Women
20
15
10
5
Social Sciences
Life Sciences
Physical Sciences
Engineering
1920
1930
1940
1950
1960
1970
Decade of Doctorate

Fig. 2

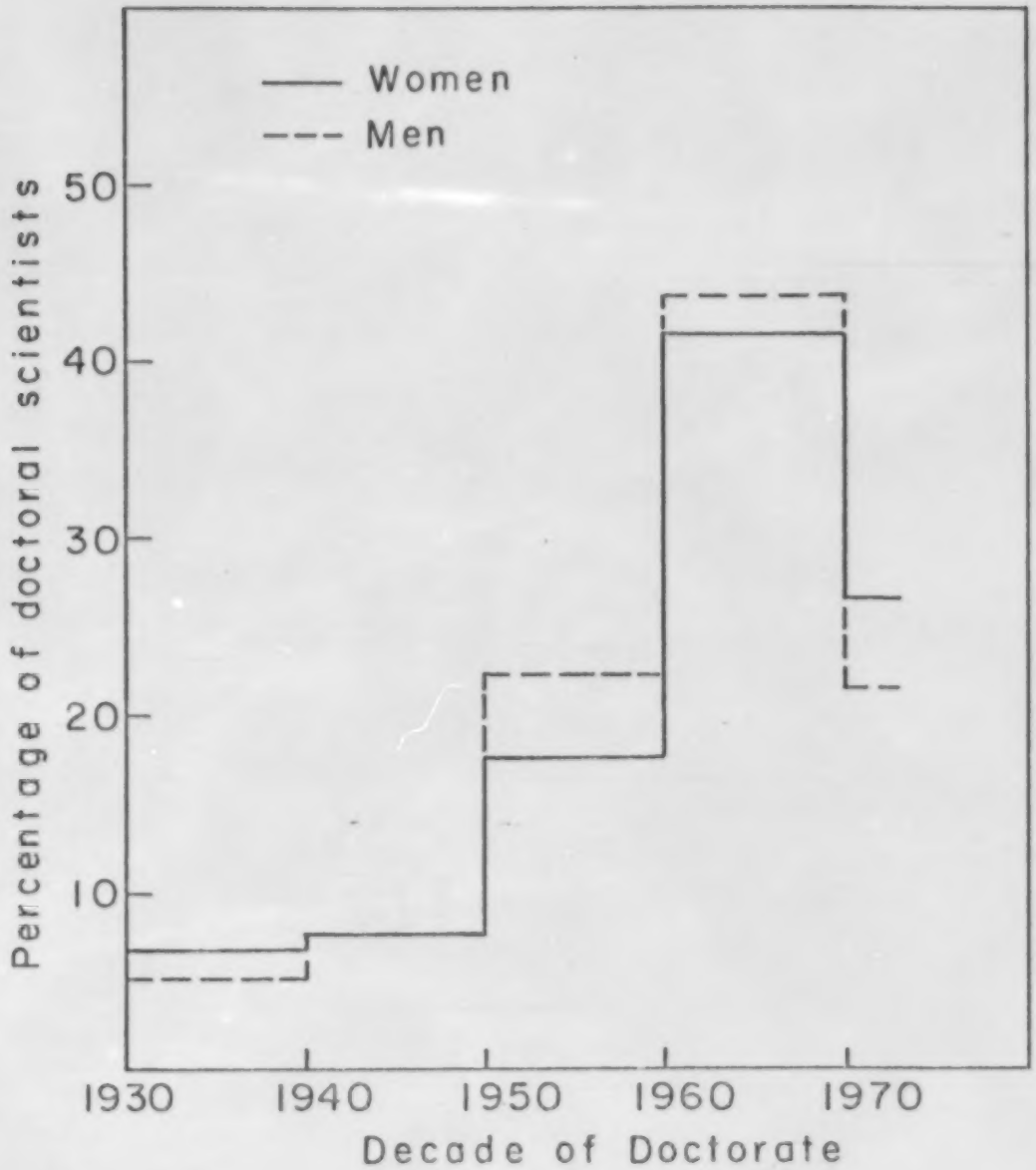
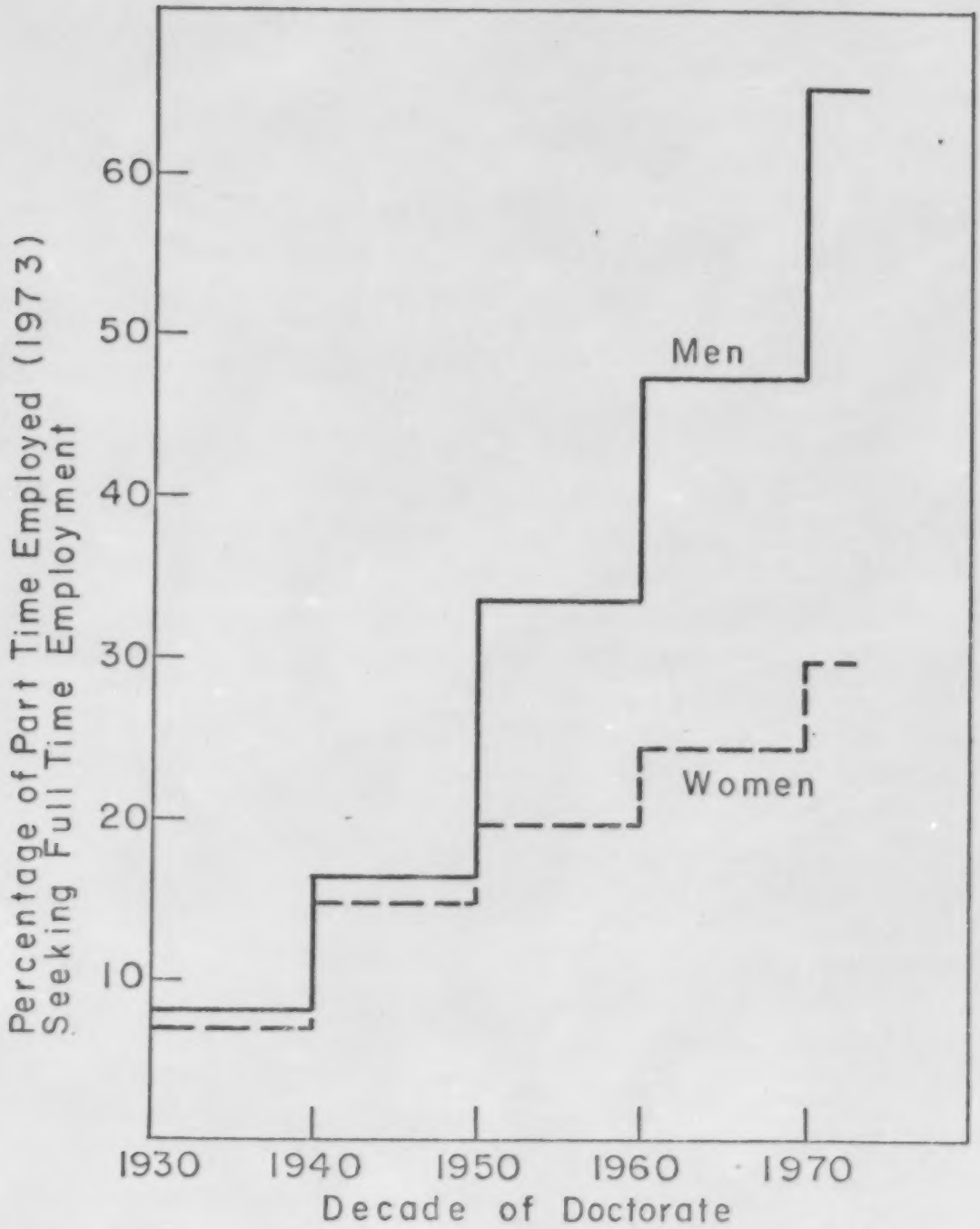
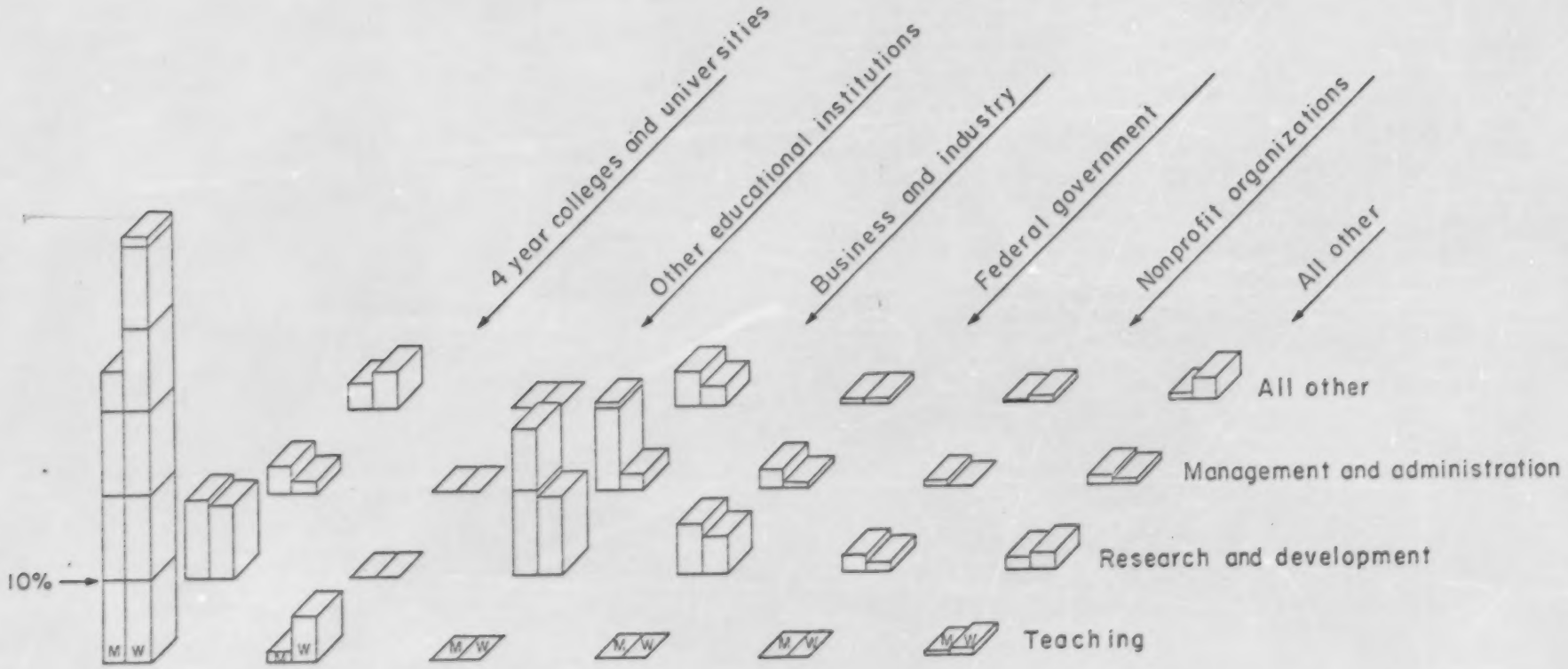

Women
Men
Percentage of doctoral scientists
50
40
30
20
10
1930
1940
1950
1960
1970
Decade of Doctorate

Fig. 3


Percentage of Part Time Employed (1973) Seeking Full Time Employment
60
50
40
30
20
10
Men
Women
1930
1940
1950
1960
1970
Decade of Doctorate

Physical Sciences – Full time employed



57

53

Fig. 4

Life Sciences – Full time employed

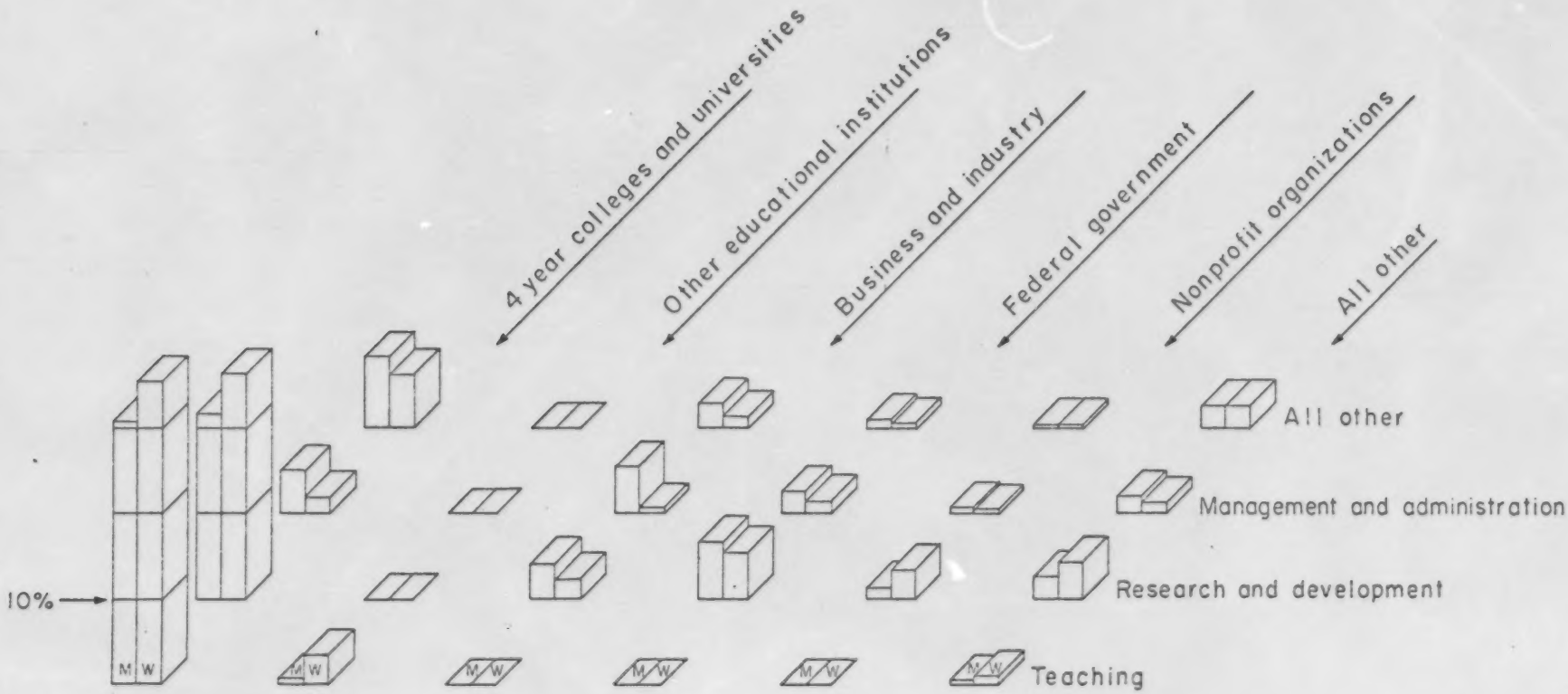


Fig. 5

Social Sciences – Full time employed

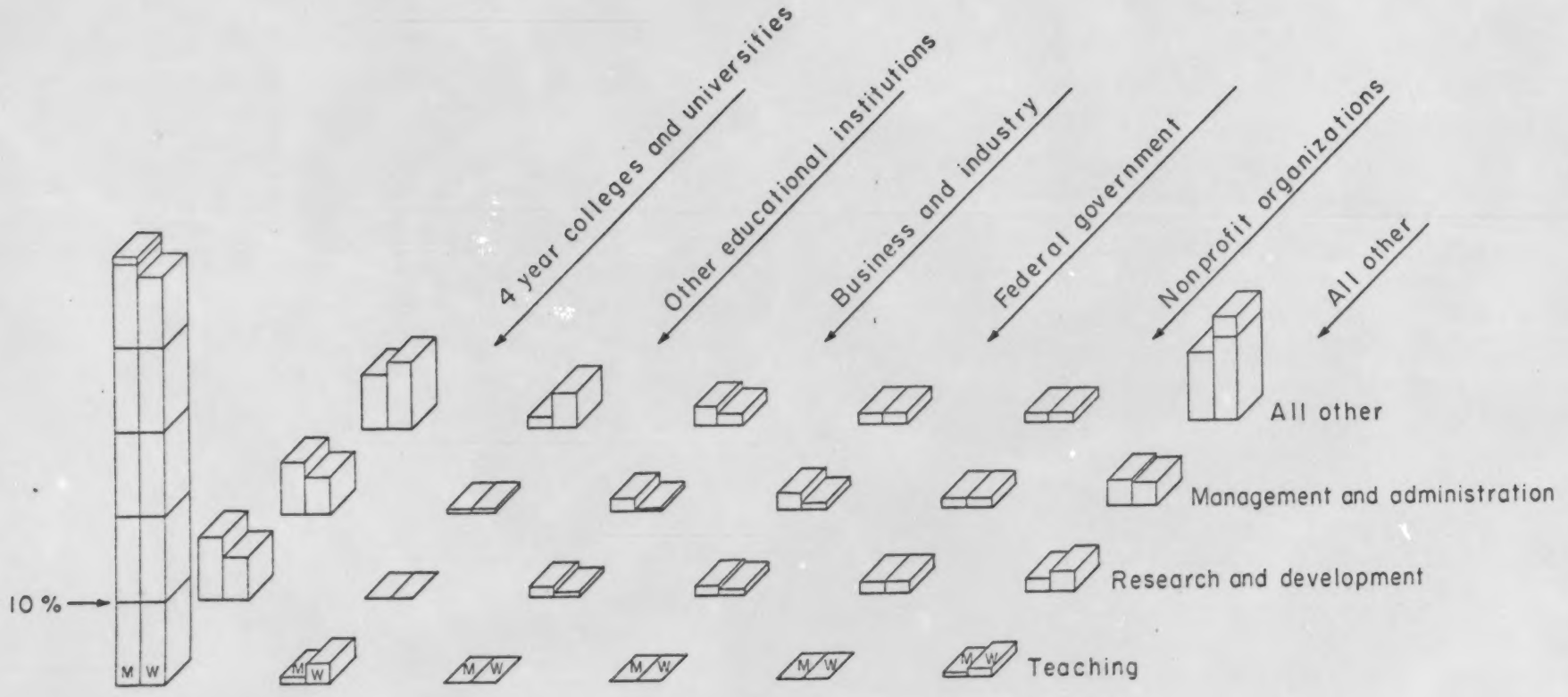
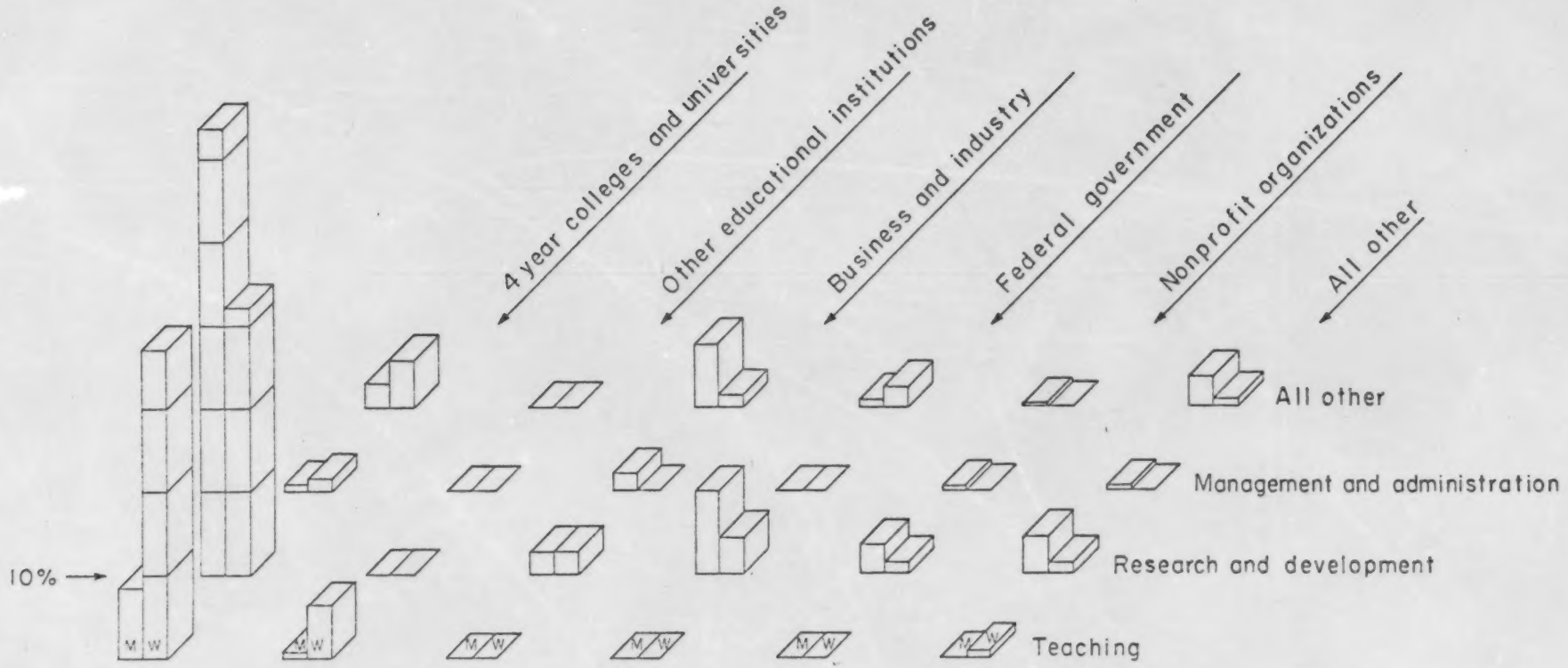


Fig. 6

Physical Sciences – Part time employed

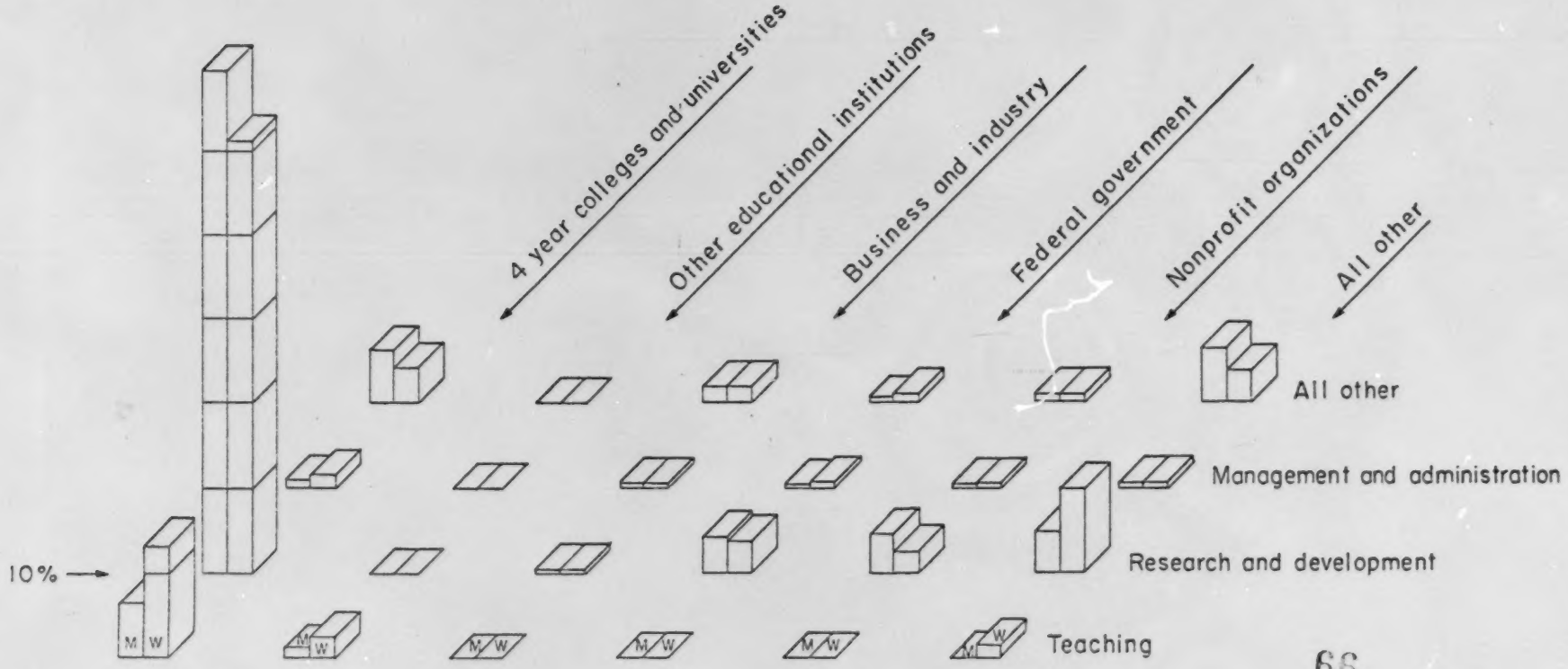


63

64

Fig. 7

Life Sciences - Part time employed

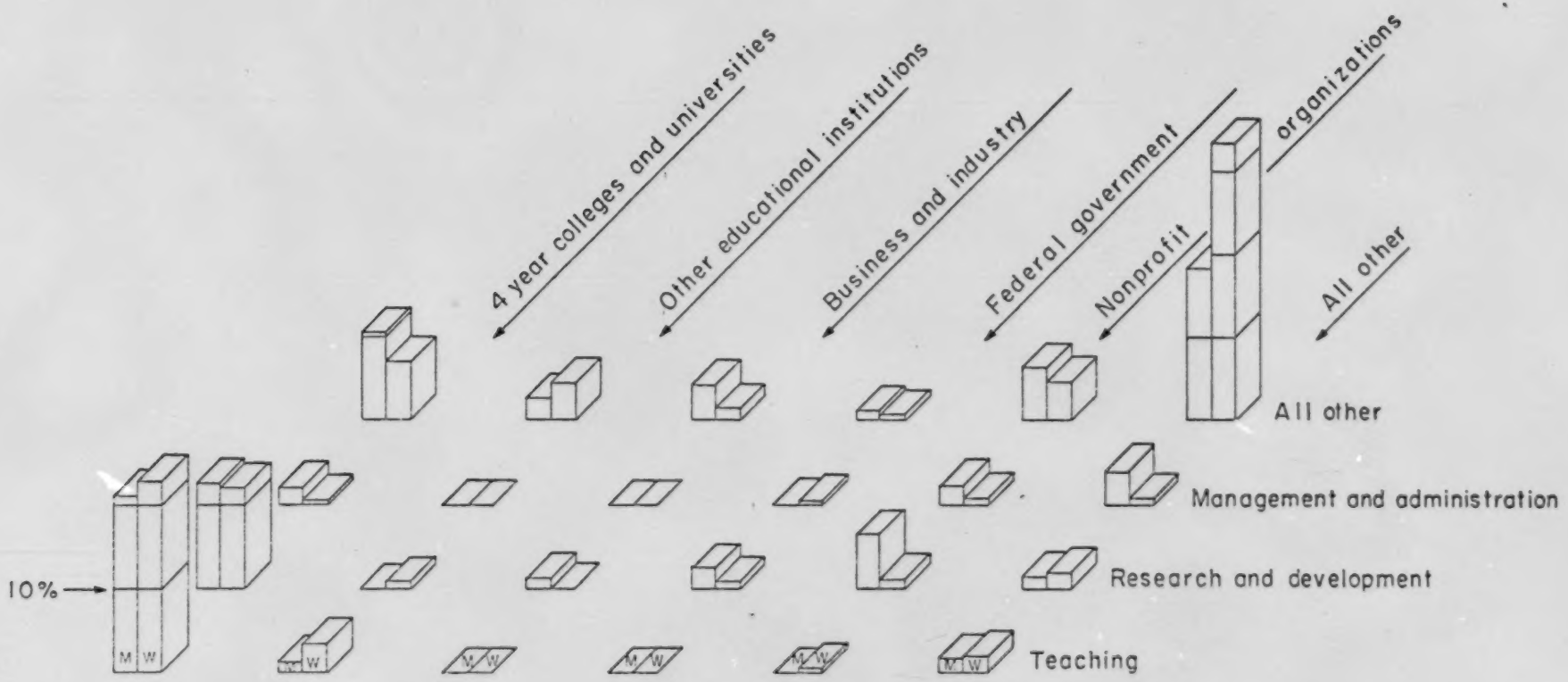


65

66

Fig. 8

Social Sciences – Part time employed



67

68

Fig. 9

Fig. 10

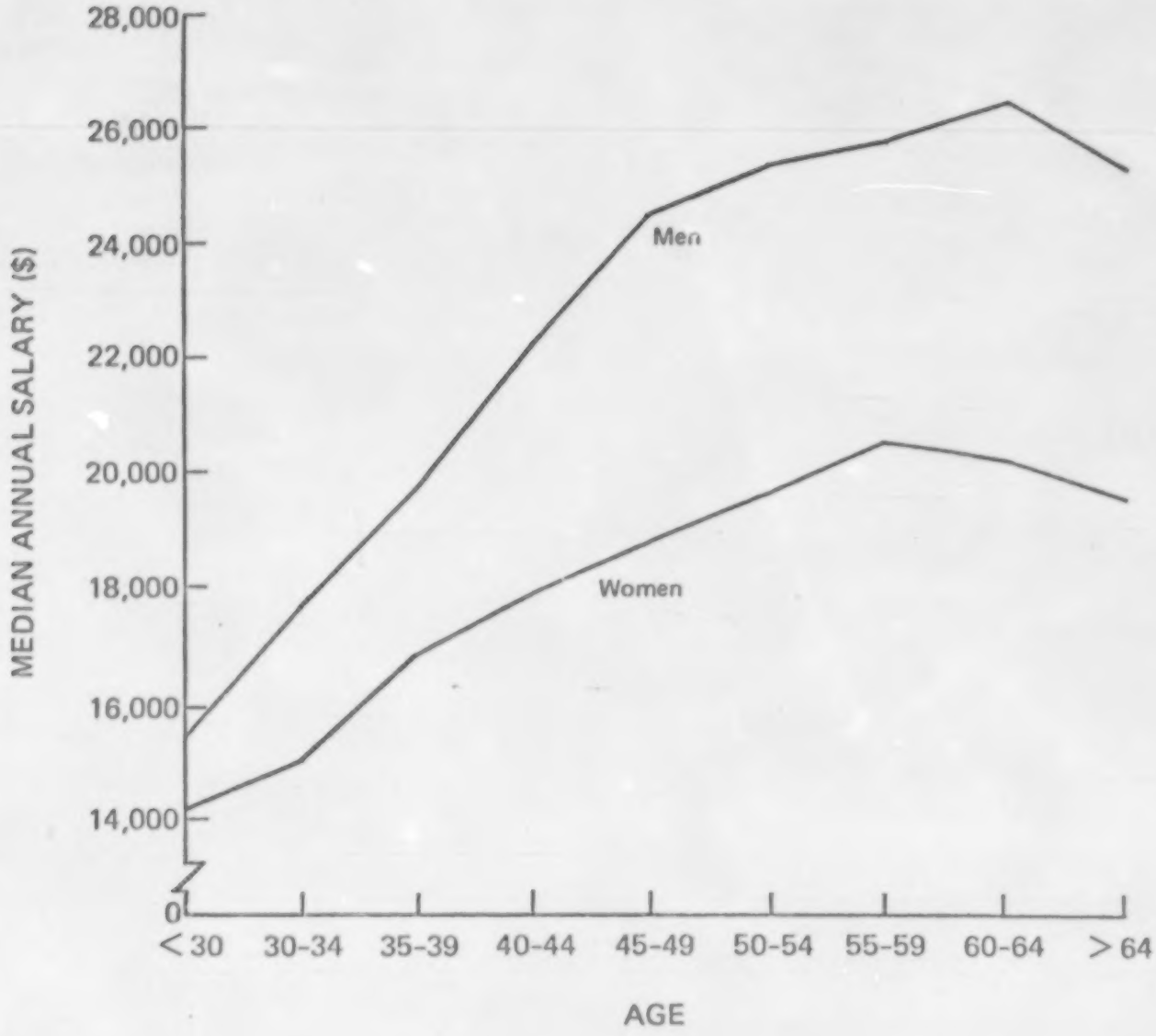

28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
0
MEDIAN ANNUAL SALARY ($)
Men
Women
< 30
30-34
35-39
40-44
45-49
50-54
55-59
60-64
> 64
AGE

Fig. 11

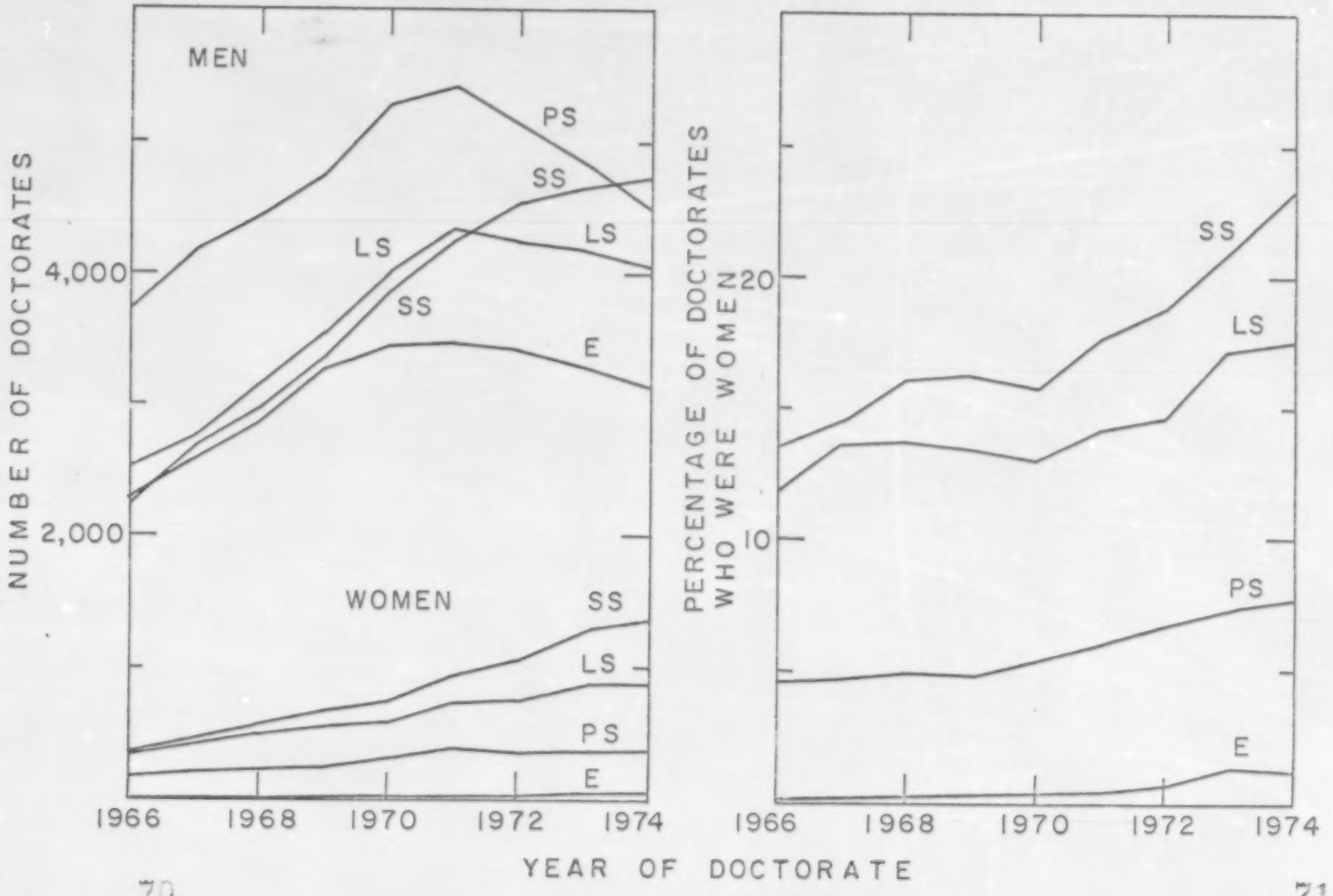

MEN
PS
SS
LS
LS
SS
E
4,000
2,000
WOMEN
SS
LS
PS
E
NUMBER OF DOCTORATES
1966
1968
1970
1972
1974
PERCENTAGE OF DOCTORATES WHO WERE WOMEN
20
10
SS
LS
PS
E
1966
1968
1970
1972
1974
YEAR OF DOCTORATE

TABLE I

Percentages of Scientists in Various Fields Who Were Women and Percentages of Women Doctorates by Field. A Comparison of Pre-1920 Data With Post-1920 Data.

Field	Percentage of Scientists in Field Who Were Women		Percentage of Women Doctorates by Field	
	1906-1920[a]	1973[b]	Before 1920[c]	1920-1971[d]
Anthropology	7.7	20.4	1	3.9
Astronomy	6.4	8.8	2	0.8
Botany	9.4	14.9	15	6.3
Chemistry	2.5	5.7	11	18.8
Geology	3.8	2.5[e]	5	1.6[e]
Home Economics (Chemistry)	100.0[f]	88[g]	5[f]	5.0[g]
Mathematics	6.3	6.7	11	7.2
Medical Sciences	4.3	10.9	8	5.1
Physics	2.6	2.1	5	3.7
Psychology	22.8	20.5	19	39.4
Zoology	8.9	12.3	18	8.1
Total Number			319	12,487

a. From M.W. Rossiter [11]. Scientists listed in "American Men of Science" without differentiation by degree level.
b. This study.
c. From M.W. Rossiter [11].
d. From "Doctorates Awarded From 1920 to 1971 By Subfield of Doctorate, Sex and Decade" [15].
e. Earth Sciences
f. Mainly degrees awarded by chemistry departments
g. Separate professional field

TABLE II

Number and Weighted Number of Doctoral Scientists By Sex and Field of Doctorate in NAS-NRC 1973 Survey of Doctoral Scientists

Field of Doctorate	Women		Men	
	Number	Weighted Number	Number	Weighted Number
Physical Sciences	2067	4002	14,552	113,844
Mathematics	526	906	1928	12,667
Physics and Astronomy	349	531	2900	21,809
Chemistry	952	2242	4403	37,027
Earth Sciences	147	191	1208	7405
Engineering	93	132	4113	34,936
Life Sciences	2167	7372	9015	53,735
Agricultural Sciences	86	176	1404	10,974
Medical Sciences	260	671	1066	5507
Biological Sciences	1821	6525	6545	37,254
Social Sciences	2205	8527	5649	48,308
Psychology	1139	5018	2432	19,464
Other Social Sciences	1066	3509	3217	28,844
Non-science, No Report	767	1360	1813	7772
Total	7206	21,261	31,029	223,659

TABLE III

Percentage of Doctoral Scientists Who Were Women by Field of Doctorate and Lists of Subfields in Which the Percentage Was Significantly Higher, or Lower.

Field of Doctorate	Percentage Women	#	Subfields: Percentage Higher*	Subfields: Percentage Lower*
Physical Sciences	4.7 ± 0.2			
Mathematics	6.7 ± 0.5	17	Algebra	Computing Theory, Topology, Applied Math
Astronomy/Astrophysics	7.5 ± 1.7	2		
Physics	2.0 ± 0.2	15		Plasma Physics, Optics
Chemistry	5.7 ± 0.3	10	Inorganic	Nuclear
Earth Sciences	2.5 ± 0.4	18	Minerology/Petrology	Stratigraphy/Sedimentation, Geophysics-Earth/Atmosphere Engineering-Economic Geology
Engineering	0.38± 0.09	23	Textile	Mechanical
Life Sciences	12.1 ± 0.3			
Agricultural Sciences	1.6 ± 0.3	13		Agronomy, Forestry
Medical Sciences	10.9 ± 0.8	12	Public Health, Medical Science - Other	Veterinary Medicine, Pathology, Pharmacy
Biological Sciences	14.9 ± 0.4	24	Anatomy, Cytology, Immunology, Nutrition (Old), Molecular Biology, Biological Science-General, Biological Science - Other	Ecology, Plant Physiology, Zoology, Entomology, Food Science and Technology
Social Sciences	15.0 ± 0.4			
Psychology	20.5 ± 0.6	16	Developmental/ Gerontological	Industrial/Personnel, Experimental Psychology, Experimental/Comparitive/ Physiological Psychology (Old)
Other Social Sciences	10.8 ± 0.4	17	Anthropology, Archeology, Sociology, Linguistics, History/Philosophy of Science	Economics, Econometrics, Geography, Public Administration/Political Science
Sciences Total	8.44± 0.14			
Non-Sciences	14.9 ± 0.6			
Total	8.68± 0.13			

Sub-fields for which the percentage differed significantly from that for the field ($P < 10\%$).

TABLE IV

Percentage of Doctoral Scientists Who Received Their Doctorates In Fiscal Years 1970, 1971 and 1972 By Sex and Field of Doctorate.

Field of Doctorate	Percentage of Doctoral Scientists	
	Women	Men
Physical Sciences	23.9 ± 0.7	18.9 ± 0.4
Engineering	35.3 ± 2.7	26.6 ± 0.4
Life Sciences	25.3 ± 0.8	20.3 ± 0.4
Social Sciences	31.0 ± 0.8	24.2 ± 0.5
Non-sciences	14.4 ± 0.8	13.1 ± 0.7
Total	26.7 ± 0.4	21.4 ± 0.2

TABLE V

Percentage of Doctoral Scientists in Given Racial or Ethnic Category by Sex.

	Percentage of Total Women In Category	Percentage of Total Men in Category	Percentage of Category Who Are Women
Racial Category			
White/Caucasian	86.2 ± 0.3	86.9	8.6 ± 0.1
Black/Negro	1.2 ± 0.1	0.7	13.4 ± 1.7
Asian	3.4 ± 0.2	3.3	8.9 ± 0.7
East Indian	0.5 ± 0.1	1.3	3.8 ± 0.8
Other/No Report	8.6 + 0.3	7.8	9.6 ± 0.5
Ethnic Category			
Puerto Rican American	0.22 ± 0.04	0.18	10.3 ± 3.1
Mexican American	(0.06)	0.15	(3)
Spanish American	0.34 ± 0.06	0.25	11.6 ± 2.5
Afro American	1.03 ± 0.10	0.60	14.1 ± 1.9
Other/No Report	98.34 ± 0.12	98.8	8.6 ± 0.1
Total			8.7 ± 0.1

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE VI

Percentage of Doctoral Scientists Who Were Foreign Born by Sex and Field of Employment.

Field of Employment	Percentage Foreign Born	
	Women	Men
Physical Sciences	19.1 ± 0.7	16.7 ± 0.4
Engineering	34.3 ± 3.1	19.2 ± 0.6
Life Sciences	17.6 ± 0.9	13.0 ± 0.3
Social Sciences	9.7 ± 0.5	10.8 ± 0.4
Non-Sciences	10.2 ± 1.2	8.6 ± 0.7
No Report	16.5 ± 2.8	20.1 ± 1.8
Not Employed	13.8 ± 0.8	12.8 ± 0.7
Total	14.0 ± 0.3	14.5 ± 0.2

TABLE VII

Percentage of Doctoral Scientists Who Received Foreign Doctorates By Sex and Field of Doctorate

Field of Doctorate	Percentage With Foreign Doctorates	
	Women	Men
Physical Sciences	4.9 ± 0.3	6.7 ± 0.2
Engineering	(6)	2.5 ± 0.2
Life Sciences	3.3 ± 0.3	3.3 ± 0.2
Social Sciences Total	1.7 ± 0.2	2.0 ± 0.2
Non-sciences	(1)	2.3 ± 0.3
All Fields	2.9 ± 0.2	4.1 ± 0.1

TABLE VIII

Percentage of Doctoral Scientists in Each Field of Doctorate By Sex and Field of Employment.

Field of Employment	Field of Doctorate									
	Physical Sciences		Engineering		Life Sciences		Social Sciences		Non-sciences	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Physical Sciences	60.2	75.5	17.6	10.1	2.9	4.4	0.4	1.5	9.7	17.5
Engineering	1.0	7.1	59.5	80.1	*	0.7	*	0.5	*	3.1
Life Sciences	9.5	5.1	----	0.8	69.4	83.7	1.6	3.0	5.0	4.0
Social Sciences	(0.2)	0.3	----	0.5	0.6	0.8	74.9	78.2	66.8	63.3
Non-sciences	5.8	4.1	*	3.5	4.5	2.7	7.0	7.9	----	----
No Report	2.5	1.7	----	1.1	1.0	1.3	1.1	1.2	(1)	1.7
Not Employed	20.7	6.3	19.1	3.8	21.4	6.4	15.0	7.5	17.3	10.5

*Less than five individuals in unweighted sample.
Brackets signify 5-9 individuals in unweighted sample.

TABLE IX

Percentage of Doctoral Scientists in Each Field of Employment By Sex and Field of Doctorate.

Field of Employment	Field of Doctorate									
	Physical Sciences		Engineering		Life Sciences		Social Sciences		Non-sciences	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Physical Sciences	85.4	88.2	0.8	5.2	7.8	3.5	1.1	1.1	4.7	2.0
Engineering	28.4	16.2	58.2	81.3	*	1.0	*	4.2	*	0.7
Life Sciences	6.5	7.8	----	0.6	89.7	88.1	2.4	2.8	1.2	0.6
Social Sciences	(0.1)	0.5	----	0.4	0.6	1.0	87.1	87.0	12.1	11.1

*Less than five individuals in unweighted sample.
Brackets signify 5 to 9 individuals in unweighted sample.

TABLE X

Percentage of Doctoral Scientists in Given Employment Category by Decade of Doctorate and Sex.

Employment Category	Total		Decade of Doctorate and Sex									
			30-39		40-49		50-59		60-69		70-73	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Full Time Employed	64.4	89.3	25.2	47.5	54.0	84.7	69.9	93.6	70.3	94.5	64.5	86.3
Part Time Employed	12.8	1.9	11.2	11.0	13.2	3.9	13.3	1.5	12.9	1.2	12.8	1.3
Post Doctoral Position	4.2	2.3	*	*	*	*	(0.8)	0.2	2.6	0.9	11.2	8.5
Unemployed-Seeking	3.3	0.9	*	0.8	1.9	0.8	3.1	0.8	3.8	0.7	3.8	1.3
Unemployed-Not Seeking	4.2	0.3	4.6	1.0	4.7	(0.3)	3.9	0.2	5.0	0.2	2.8	0.2
Retired	4.8	2.3	43.4	31.7	15.7	5.8	3.2	0.9	0.4	0.1	0.2	----
Other, No Report	6.1	2.9	14.9	8.0	10.2	4.3	5.8	2.8	4.9	2.3	4.8	2.4

*Less than five individuals in unweighted sample.

Brackets signify 5-9 individuals in unweighted sample.

TABLE XI

Percentage of Doctoral Scientists in Given Employment Category by Field of Doctorate and Sex.

Employment Category	Field of Doctorate and Sex											
	Physical Sciences		Engineering		Life Sciences		Social Sciences		Non-Sciences		Total	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Full Time Employed	60.3 ± 1.1	88.8	72.7 ± 2.5	94.1	61.3 ± 0.9	87.8	67.5 ± 0.9	89.2	73.3 ± 1.1	86.8	64.4 ± 0.5	89.3
Part Time Employed	13.9 ± 0.5	1.9	10.6 ± 1.7	1.3	9.6 ± 0.5	2.1	15.9 ± 0.7	2.5	9.4 ± 0.7	2.7	12.8 ± 0.3	1.9
Post Doctoral Position	5.1 ± 0.4	3.0	---	0.7	7.6 ± 0.5	3.7	1.6 ± 0.2	0.8	*	(0.5)	4.2 ± 0.2	2.3
Unemployed-Seeking	4.4 ± 0.3	1.3	(5)	0.8	3.7 ± 0.3	0.6	2.6 ± 0.3	0.6	2.2 ± 0.4	(0.6)	3.3 ± 0.2	0.9
Unemployed-Not Seeking	6.0 ± 0.4	0.3	(8)	0.2	5.6 ± 0.4	0.3	2.4 ± 0.3	0.2	1.9 ± 0.2	*	4.2 ± 0.2	0.3
Retired	6.2 ± 0.4	2.5	*	0.9	5.2 ± 0.4	2.7	3.7 ± 0.4	2.5	6.0 ± 0.6	4.2	4.8 ± 0.2	2.3
Other, No Report	4.0 ± 0.3	2.2	*	2.1	6.8 ± 0.4	2.9	6.3 ± 0.4	4.3	7.3 ± 0.6	5.5	6.1 ± 0.2	2.9

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XII

Percentage of Doctoral Scientists in Given Field of Employment by Employment Status and Sex

Employment Status	Field of Employment and Sex					
	Total Employed[a]		Physical Sciences		Engineering	
	Women	Men	Women	Men	Women	Men
Full Time Employed	79.0 ± 0.4	95.5 ± 0.1	78.5 ± 1.0	95.4 ± 0.4	89.6 ± 2.0	97.7 ± 0.2
Part Time Employed	15.8 ± 0.4	2.1 ± 0.1	15.6 ± 0.8	1.5 ± 0.1	10.4 ± 2.0	1.6 ± 0.2
Post Doctoral	5.2 ± 0.2	2.4 ± 0.1	5.8 ± 0.5	3.1 ± 0.2	---	0.7 ± 0.1
	Life Sciences		Social Sciences		Non-Sciences	
	Women	Men	Women	Men	Women	Men
Full Time Employed	78.4 ± 0.8	93.7 ± 0.4	79.7 ± 0.8	96.5 ± 0.7	83.0 ± 1.6	95.2 ± 0.6
Part Time Employed	10.9 ± 0.6	1.8 ± 0.1	18.8 ± 0.8	2.6 ± 0.3	17.1 ± 1.6	4.6 ± 0.5
Post Doctoral	10.9 ± 0.6	4.5 ± 0.2	1.6 ± 0.2	0.9 ± 0.2	---	*

* Less than five individuals in unweighted sample.

[a] Full and part time employed and post doctoral scientists.

TABLE XIII

Percentage of Part Time Employed Doctoral Scientists Seeking Full Time Employment and Percentage of Total Who are Seeking Employment by Sex and Field of Doctorate.

Field of Doctorate	Part Time Seeking Full Time Employment		Total Seeking Employment[a]	
	Women	Men	Women	Men
Physical Sciences	27 ± 2	39 ± 3	8.8 ± 0.4	2.1 ± 0.1
Mathematics	18 ± 3	34 ± 9	3.5 ± 0.8	1.8 ± 0.3
Physics/Astronomy	41 ± 4	47 ± 6	14.0 ± 1.1	2.5 ± 0.3
Chemistry	23 ± 3	40 ± 5	10.0 ± 0.8	2.2 ± 0.2
Earth Sciences	50 ± 5	29 ± 7	11.0 ± 1.2	1.3 ± 0.3
Engineering	*	38 ± 6	(10)	1.3 ± 0.2
Life Sciences	27 ± 3	23 ± 3	7.7 ± 0.3	1.1 ± 0.1
Social Sciences	20 ± 2	27 ± 4	6.8 ± 0.4	1.4 ± 0.1
Psychology	17 ± 2	16 ± 4	7.3 ± 0.7	1.1 ± 0.2
Other Social Sciences	27 ± 4	36 ± 5	6.1 ± 0.6	1.6 ± 0.2
Non-sciences	18 ± 3	16 ± 5	4.4 ± 0.5	1.2 ± 0.2
Total	23.2±1.2	31.3 ± 1.7	7.4 ± 0.2	1.6 ± 0.1

[a]Percencentage of total individuals in each category who are unemployed-seeking employment or part time seeking full time employment.

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XIV

Percentage of Doctoral Scientists Employed in Non-Scientific Employment by Field of Doctorate and Sex.

Field of Doctorate	Percentage in Non-Scientific Employment			
	Full Time Employed		Part Time Employed	
	Women	Men	Women	Men
Physical Sciences	8.5	5.2	18.5	26.0
Engineering	*	4.1	----	(10)
Life Sciences	6.8	3.4	10.6	9.2
Social Sciences	9.6	9.5	5.4	13.1
Total	8.2 ± 0.3	5.3 ± 0.1	8.7 ± 0.8	13.9 ± 1.2

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XV

Percentage of Women Doctoral Scientists Full Time Employed in a Given Field of Employment by Employer

Field of Employment	Employer					
	College/Univ.	Other Ed.	Bus./Ind.	Fed. Gov.	Non-profit	All Other
Physical Sciences	66.0	5.8	14.7	5.9	2.0	6.1
Math	85.3	3.8	5.9	2.0	0.5	3.7
Physics	62.9	4.8	11.7	12.4	3.8	4.5
Chemistry	53.3	8.2	23.4	5.3	2.7	7.0
Earth Sciences	58.2	3.0	11.4	12.9	1.5	12.9
Engineering	28.9	*	43.8	14.0	(5)	10.7
Life Sciences	70.3	3.6	4.7	7.8	4.2	9.4
Social Sciences	65.8	7.3	2.0	2.9	3.7	18.3
Psychology	53.6	10.4	2.3	2.7	3.6	27.4
Other Social Sciences	85.3	2.4	1.5	3.2	4.0	3.7
All Fields	66.4	6.0	5.7	5.2	3.9	12.8

*Less than five individuals in unweighted sample.
Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XVI

Percentage of Doctoral Scientists Full Time Employed in a Given Field of Employment by a Given Employer Who Were Women

	Employer						
Field of Employment	College/Univ.	Other Ed.	Bus./Ind.	Fed. Govt.	Non-profit	All Other	Total
Physical Sciences	4.2	11.7	1.5	2.1	2.2	5.3	3.2
Math	5.4	11.9	2.4	2.5	*	6.6	5.0
Physics	2.1	6.6	1.0	1.6	(2)	(2)	1.8
Chemistry	5.4	16.1	1.6	3.4	4.4	7.6	3.5
Earth Sciences	2.4	(4)	1.2	1.4	*	3.8	2.0
Engineering	0.3	*	0.3	0.7	(0.5)	0.8	0.4
Life Sciences	9.1	25.3	3.4	6.5	13.0	10.1	8.6
Social Sciences	11.4	28.1	5.5	8.2	12.6	16.3	12.2
Psychology	14.7	30.2	6.7	11.5	14.3	18.2	15.8
Other Social Sciences	9.3	18.8	3.8	5.9	10.8	7.3	9.0
All Fields	7.6	19.8	1.6	4.2	7.6	10.9	6.4

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XVII

Percentage of Women Doctoral Scientists Part Time Employed in a Given Field of Employment by Employer.

	Employer					
Field of Employment	College/Univ.	Other Ed.	Bus./Ind.	Fed. Govt.	Non-profit	All Other
Physical Sciences	75.2	6.6	4.2	7.3	(2)	3.6
Engineering	(64)	---	*	*	---	---
Life Sciences	70.1	2.4	3.2	5.4	3.7	15.3
Social Sciences	42.3	8.7	1.7	2.1	7.2	38.1
Psychology	32.4	10.8	2.0	2.1	6.7	46.0
Other Social Sciences	72.2	2.4	0.5	1.9	8.9	14.0
All Fields	57.3	6.8	3.0	4.0	5.2	23.7

*Less than five individuals in unweighted sample.
Brackets signify 5 to 9 individuals in unweighted sample.

99

TABLE XVIII

Percentage of Doctoral Scientists Part Time Employed in a Given Field of Employment by a Given Employer Who Were Women

	Employer						
Field of Employment	College/Univ.	Other Ed.	Bus./Ind.	Fed. Gov.	Non-profit	All Other	Total
Physical Science	18.5	58.2	6.2	11.4	8.0	7.4	16.4
Engineering	(3)	----	*	*	----	----	1.7
Life Sciences	26.9	43.3	26.5	29.5	20.4	33.6	27.7
Social Sciences	47.5	65.0	23.6	35.6	31.3	59.9	49.5
Psychology	61.6	76.1	33.8	53.3	38.7	64.3	60.4
Other Social Sciences	36.2	(22)	*	(17)	21.8	35.6	32.0
All Fields	27.1	57.7	10.1	19.4	22.5	36.7	27.7

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XIX

Percentage of Doctoral Scientists Full Time Employed at Four Year Colleges and Universities Who Were Women by Academic Rank and Field of Employment.

Field of Employment	Academic Rank: Professor	Assoc. Prof.	Assist. Prof.	Other/No Report	Total
Physical Sciences	2.8	4.2	5.4	4.5	4.0
Math	4.5	5.2	6.2	9.5	5.4
Physics	0.9	2.2	3.5	2.7	2.1
Chemistry	3.3	6.2	6.9	7.4	5.3
Earth Sciences	1.5	1.2	3.6	5.7	2.4
Engineering	*	(0.4)	0.7	*	0.3
Life Sciences	5.3	8.2	8.8	18.6	7.8
Social Sciences	6.7	10.9	16.8	17.5	11.1
Psychology	9.3	12.7	22.6	16.7	14.3
Other Social Sciences	5.3	9.8	13.3	18.4	9.2
All Fields	4.6	7.2	9.8	10.3	7.0

*Less than five individuals in unweighted sample.
Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XX

Percentage of Women Doctoral Scientists Full Time Employed at Four Year Colleges and Universities in a Given Field of Employment by Academic Rank.

	Academic Rank			
Field of Employment	Professor	Assoc. Prof.	Assist. Prof.	Other/No Report
Physical Sciences	25.2	28.8	34.2	11.7
Math	28.2	28.4	37.4	6.0
Physics	16.3	27.5	34.8	21.3
Chemistry	24.9	33.6	29.1	12.3
Earth Sciences	24.3	13.9	36.5	25.2
Engineering	*	(42)	48.5	*
Life Sciences	28.3	30.0	25.2	16.4
Social Sciences	24.1	28.6	40.0	7.4
Psychology	24.4	26.1	42.0	7.6
Other Social Sciences	23.8	30.9	38.0	7.2
All Fields	25.9	29.5	33.6	11.0

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XXI

Percentage of Doctoral Scientists Part Time Employed at Four Year Colleges and Universities by Academic Rank and Sex.

Academic Rank	Percentage of Category Who Were Women	Percentage of Total Women in Category
Professor	15	8
Associate Professor	45	10
Assistant Professor	51	22
Instructor	100	7
Lecturer	47	12
Other	65	29
No Report	41	11
Total	44	

TABLE XXII

Percentage of Doctoral Women Scientists Full Time Employed at Four Year Colleges and Universities with Given Academic Rank by Date of Doctorate

Rank	Date of Doctorate					
	>1969	1965-69	1960-64	1955-59	1950-54	< 1950
Professor	1.2	13.2	21.9	20.2	20.1	23.3
Associate Professor	12.5	42.8	22.8	10.9	3.9	7.0
Assistant Professor	55.9	34.7	5.2	2.2	1.8	*
Instructor	63.2	*	*	*	*	*
Lecturer	(27)	35.9	(15)	*	*	*
Other/No Report	39.9	22.4	12.8	10.3	8.4	6.2
Total	27.2	30.3	15.5	10.1	7.8	8.8

*Less than five individuals in unweighted sample.
Brackets signify 5 to 9 individuals in unweighted sample.

TABLE XXIII

Percentage of Doctoral Scientists Full Time Employed At Four Year Colleges and Universities Who Were Women By Academic Rank and Date of Doctorate

Rank	Total	Date of Doctorate					
		> 1969	1965-69	1960-64	1955-59	1950-54	< 1950
Professor	4.6	3.9	6.1	4.2	4.1	4.2	5.2
Associate Professor	7.2	8.2	5.7	6.5	11.1	12.0	27.7
Assistant Professor	9.8	9.2	9.3	19.0	41.7	55.6	*
Instructor	19.7	15.2	*	*	*	*	*
Lecturer	20.2	(16)	25.2	(28)	*	*	*
Other/No Report	9.2	11.2	8.6	8.4	9.4	8.3	6.3
Total	7.0	9.3	7.2	5.9	6.0	5.4	6.7

*Less than five individuals in unweighted sample.

Brackets signify 5 to 9 individuals in unweighted sample.

193

TABLE XXIV

Median Salaries of Women Doctoral Scientists and Percentage Difference[a] of Median Salaries of Men Doctoral Scientists Full Time Employed by Field of Employment and by Employer.

Field of Employment	Total		Employer									
			Bus/Ind.		4 Yr. Coll/Univ.		Hosp/Clinic		Non-profit		Fed. Gov.	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Math	17,186	16.0	16,894	38.5	16,994	12.4	----	---	21,617	13.1	22,450	6.1
Physics	17,833	19.0	21,681	9.9	16,684	15.2	----	---	16,200	30.2	21,200	9.7
Chemistry	17,142	24.5	20,650	9.7	15,636	18.7	12,055	59.9	17,763	23.1	19,650	21.9
Earth Science	16,916	23.2	16,200	42.9	16,405	16.0	----	---	11,200	87.1	21,894	9.4
Engineering	19,650	14.5	19,236	22.1	18,325	14.1	----	---	21,950	30.2	25,367	-7.8
Life Science	17,197	18.2	18,531	27.0	16,716	15.3	15,381	42.0	16,992	21.8	21,718	6.5
Psychology	18,110	13.6	21,325	31.8	17,554	10.2	18,239	8.7	17,191	34.0	22,271	10.2
Other Social Sciences	17,460	18.0	19,638	46.3	17,158	15.0	----	---	21,533	14.2	24,424	12.2
Total	17,621	20.1	19,712	19.0	17,070	14.2	17,510	15.5	17,905	25.7	22,165	7.4

[a] Percentage Difference = $\frac{\text{(Median Salary Men)} - \text{(Median Salary Women)}}{\text{(Median Salary Women)}} \times 100$

TABLE XXV

Median Salaries of Women Doctoral Scientists and Percentage Difference[a] of Median Salaries of Men Doctoral Scientists Full Time Employed in Four Year Colleges and Universities by Academic Rank and Year of Doctorate.

Rank	Total Sample		Date of Doctorate: > 1969		1960-69		1950-59		1940-49		1930-39	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Total	17,600	10.2	14,900	5.3	17,600	6.8	21,000	15.1	20,900	27.2	20,600	29.5
Professor	21,600	11.7	*	*	20,600	9.6	22,400	11.9	22,200	20.5	22,600	20.4
Associate Professor	17,900	2.6	17,200	2.2	17,700	3.7	19,000	1.5	18,100	1.6	*	*
Assistant Professor	15,300	4.4	14,300	7.6	16,100	3.2	16,600	*	*	*	*	*
Instructor	13,600	-9.5	13,000	-6.8	14,700	*	*	*	*	*	*	*
Lecturer	14,500	12.0	*	*	14,600	*	*	*	*	*	*	*

*Sample too small to compute median salary.

[a]Percentage Difference = $\frac{\text{(Median Salary Men)} - \text{(Median Salary Women)}}{\text{(Median Salary Women)}} \times 100$